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ANALYSIS OF ELECTRIC POWER REQUIRED AND AVAILABLE IN COLORADO AND WYOMING

1942-1944

by

H. S. SANDS
Consulting Engineer

and

SURVEY OF POTENTIAL INCREASE IN PRODUCTION OF STRATEGIC AND CRITICAL MINERALS IN THE STATES OF COLORADO AND WYOMING and THE APPROXIMATE INCREASED ELECTRIC POWER REQUIREMENTS

by

GUSTAVUS SESSINGHAUS
Mining Engineer

JANUARY 1943

COLORADO WATER CONSERVATION BOARD
Clifford H. Stone, Director
C. L. Patterson, Chief Engineer
R. J. Tipton, Consulting Engineer

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ANALYSIS OF ELECTRIC POWER
REQUIRED AND AVAILABLE

IN

COLORADO AND WYOMING

1942 - 1944

H. S. SANDS
Consulting Engineer
Denver, Colorado

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HERBERT S. SANDS
Consulting Engineer
First National Bank Building
Denver, Colorado

January 19, 1943

Hon. Clifford H. Stone, Director
Colorado Water Conservation Board
State Office Building
Denver, Colorado

Dear Judge Stone:

I am transmitting to you herewith a report made for the purpose of determining the availability of electric power in the State of Colorado for industrial and military establishments. Power available in Wyoming is also included in the study because the electric systems in Wyoming are so closely interconnected with those of Colorado. The same is true of the power generated in Dawson, New Mexico since it helps southern Colorado to carry some of their loads.

Studies have also been made of the advantages that could be had by interconnection of certain utilities not now interconnected.

The total demands of December, 1941 are taken as the basis for the report, and forecasts of the total peaks for 1942-43 are made.

All of this is transmitted in accordance with your request.

Sincerely yours,

I N D E X

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INTRODUCTION

This survey and report is made for the purpose of determining the availability of presently existing load demands of electric power for developing mining of strategic metals, military establishments, and war industries, particularly in the state of Colorado but also showing the inter-relations with the states of Wyoming and New Mexico.

The presentation includes the following items:

1. Dependable capacity of existing generating facilities as presently interconnected.
2. Consideration of increases in capacity made available by interconnection of adjacent generating facilities with existing systems.
3. Present total demands on generating and transmission facilities.
4. Forecasts of total peak demands for 1942 and 1943.
5. Resultant available capacities.
6. Consideration of increases in capacity made available by generating facility installations and major system interconnections having regard for the saving of time, money, and strategic materials.

The basic information for the survey was obtained from reports filed by the utilities with the Federal Power Commission and with Public Utilities Commissions, from the records of the Colorado Water Conservatio Board, and directly from the utilities in the areas covered by this report.

The report portrays the conditions that existed on January 1, 1942, and estimates are included which bring the conditions up to Januar 1, 1943 and January 1, 1944. There is also shown the amount of power tha

can be delivered from the present existing surplus capacity to various load centers with the present transmission facilities.

The State of Colorado and the adjoining states of Wyoming and New Mexico have been laid out into nine distinct power areas. Studies were made on all of the areas which lie entirely or partly in Colorado. The practical value of the interconnection of isolated plants or systems in each power area is considered under each area and the effect of interconnection of the various areas is considered in the last part.

The power areas selected are designated as follows:

I. Wyoming and Northern Colorado
II. Colorado Springs, Colorado, and East
III. Arkansas Valley, Colorado
IV. Walsenburg and Trinidad, Colorado, and Dawson, New Mexico
V. San Luis Valley, Colorado
VI. Southwestern Colorado
VII. North Central New Mexico
VIII. Las Vegas, New Mexico
IX. Southwestern New Mexico

The outlines of these areas are indicated on the following drawing. No studies for areas VII, VIII, and IX in New Mexico are included in this report.

There is shown additional capacity that can be obtained by interconnection of plants and systems not now operating interconnected, together with estimates of probable expense of, and time required for, such interconnection.

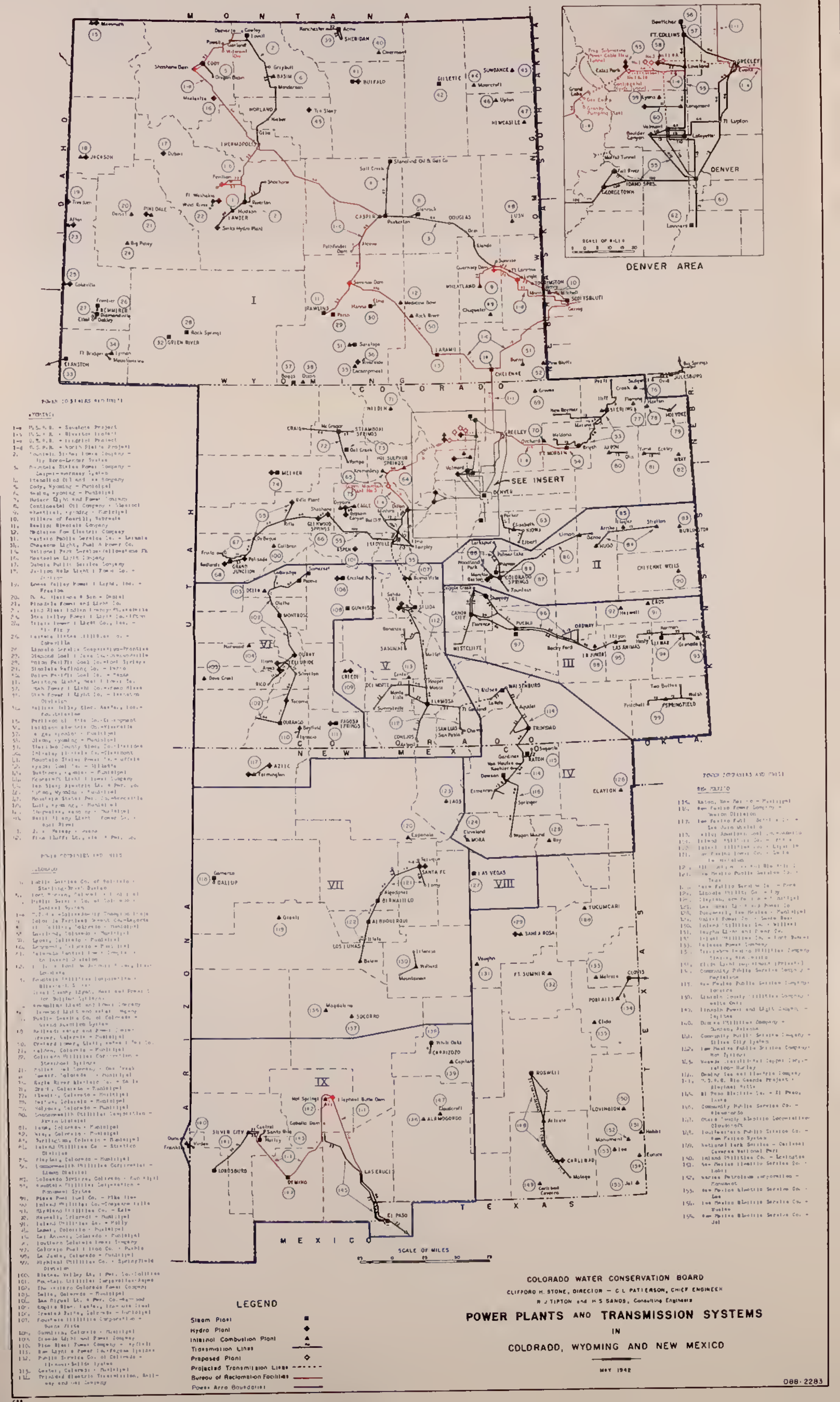
Also is shown the cost, capacity, time of installation, and most economical location of additional capacity of generation and transmission facilities which may be required for war industries at load centers within the area.

Lastly is shown the cost of and time required for interconnecting power areas and the benefits to be derived from each such interconnection, whereby any surplus capacity in one power area is made available to load centers in other power areas.

In presenting the results of the survey, each area first will be treated separately. The conditions described relating to the interconnection of the power areas will be presented later in this report.

The estimation of the time required for various interconnections and installations of generating and transmission facilities is predicated on the assumption that a necessity for these various operations will be sufficiently urgent so that priorities will be granted which will permit the securing of the necessary materials as expeditiously as possible.

The report is based on the annual peak, actual for 1941 and estimated for 1942 and 1943. Some of the hydro plants are purely peaking plants and will operate at comparatively low capacity factors. Nevertheless, checks have been made that reveal there will be ample firm capacity for the interconnected systems to operate satisfactorily at the load factor that will exist.



LEGEND

Steam Plant ■
Hydro Plant ◆
Internal Combustion Plant ▲
Transmission Lines
Proposed Plant ◇
Projected Transmission Lines - - - - -
Bureau of Reclamation Facilities
Power Area Boundaries

COLORADO WATER CONSERVATION BOARD
CLIFFORD H. STONE, DIRECTOR — C. L. PATTERSON, CHIEF ENGINEER
R. J. TIPTON and H. S. SANDS, Consulting Engineers

POWER PLANTS AND TRANSMISSION SYSTEMS IN COLORADO, WYOMING AND NEW MEXICO

MAY 1942

088-2283

ANALYSIS OF THE POWER SYSTEMS
IN WYOMING AND NORTHERN COLORADO
DESIGNATED AS AREA I

BEING A PART OF THE ANALYSIS
OF ELECTRIC POWER
REQUIRED AND AVAILABLE
IN COLORADO AND WYOMING

AREA I

1. Area I is described in the introduction as including Wyoming and Northern Colorado. More specifically it includes most of those systems in Wyoming and those systems in Colorado that are now interconnected that can be or are capable of interconnection as a practicable matter. This area extends from Northern Wyoming to Denver, and to a point approximately thirty miles south of Denver, from Denver to the Northeastern portion of Colorado on the East, to Grand Junction on the West, and contains over 2,000 miles of transmission lines.

2. In Area I, as thus defined in this report, it is found that on January 1, 1942 there was a dependable capacity of 235,679 kw. at the existing plants and a reserve capacity required of 29,000 kw., leaving a net assured capacity of 206,679 kw.; the sum of the 1941 system peaks was 163,262 kw., leaving a surplus capacity available of 43,417 kw. These values, which are based on non-simultaneous peaks, are more clearly shown in Table I-A. In this table the Stanolind Oil and Gas Company is shown as having a dependable capacity of 25,000 kw. and a peak of 6,500 kw. This is the correct figure for the generating plant, as of January 1, 1942. Since January 1, 1942, one 12,500 kw. unit of the Stanolind Oil and Gas Company has been disposed of and moved outside the area. This would reduce the dependable capacity shown in Table I-A from 235,679 kw. to 223,179 kw., the total net assured capacity from 206,679 kw. to 194,179 kw., and the surplus capacity in the area based on the 1941 peak from 43,417 kw. to 30,917 kw.

3. Table I-A shows dependable winter peak capacities, reserve capacities required, net assured capacities resulting, and the 1941 peak loads in kilowatts for each system and the total interconnection, as well as the 1941 net energy for load in kwh.

The dependable capacity in Table I-A is the total load in kilowatts which the station could carry continuously for one hour or longer under operating conditions usually experienced at the time of the peak load on the system.

The reserve capacity required for the system is the capacity of the largest boiler or generating unit in the system.

The net assured capacity is the system capacity during the outage of the largest unit on the system.

The peak is the annual maximum load on the generating system of the plants of the companies cited. For instance, the plant of the city of Fort Morgan shows a peak of 300 kw., which was the peak on their own generating system and a kilowatthour load for 1941 of 2,995,914 kwh., which was the total amount of energy both purchased and generated, which they furnished to the load.

In the Kendrick Project of the United States Bureau of Reclamation, reserve is shown as zero, since there is in winter months only enough water available to generate dependably 10,000 kw., while there are three machines of 12,000 kva. capacity each in the plant.

The column headed "1941 loads - KWH" shows the 1941 net energy furnished to the load of the system and does not relate to the 1941 peaks. This value represents in each case sales to ultimate consumers, to distributing utilities having no generating facilities, and to utilies classified by the Federal Power Commission as Class III: i.e., those whose system requirements are less than 10,000,000 kwh. per year. The total of the

individual values checks with the total generation of the interconnected systems in this area.

4. In Table I-A it will be noted that the interconnection of the Public Service Company of Colorado in its Sterling-Brush system with the system of the United States Bureau of Reclamation at Brush is assumed as already accomplished. This inclusion is made because the interconnection is very simple and inexpensive.

LOAD AND SUPPLY DATA FOR INTERCONNECTED POWER SYSTEMS IN AREA I   TABLE NO. I-A

Capacities as of January 1, 1942

	Dependable Capacity	Reserves	Net Assured Capacity	1941 Peaks KW	1941 Loads KWH
Public Service Co. of Colorado					
Central System	158,760 kw.	29,000 kw.	129,760 kw.	116,440	557,646,867
Grand Junction System	5,140	2,000	3,140	4,780	16,020,695
Cheyenne Light, Fuel, & Power Co.	5,800	1,500	4,300	6,400	25,405,439
Western Public Service Company					
Laramie System	6,010	2,700	3,310	4,700	21,649,470
Mountain States Power Company					
Casper-Guernsey System	4,000	2,500	1,500	4,780	19,073,068
Big Horn-Lander System	190	100	90	5,336	20,519,540
U. S. Bureau of Reclamation					
North Platte Project	1,800	1,800	0	5,777	26,236,980
Kendrick Project	10,000	0	10,000	2,976	23,324,873
Shoshone Project	5,600	4,000	1,600	710	1,957,769
Riverton Project	1,600	800	800	423	2,186,802
Stanolind Oil & Gas Company *	25,000	12,500	12,500	6,500	37,125,335
Fort Morgan, Colorado	2,800	1,200	1,600	300	2,995,914
Loveland, Colorado	1,000	600	400	1,060	3,442,818
Rawlins Electric Company	1,410	600	810	0	1,151,105
Glenwood Light & Water Company	200	200	0	200	1,396,940
Cody, Wyoming	160	160	0	0	1,254,480
Basin, Wyoming	316	136	180	380	1,160,000
Grand County L., H. & Power Co.	30	30	0	0	0
Kremmling Light & Power Company	157	75	82	60	26,440
Redlands Water & Power Company	1,000	1,000	0	Incl. with load of Gr. Junc.	
Wheatland, Wyoming	156	100	56	Incl. in North Platte Project	
Public Service Co. of Colorado					
Sterling-Brush	5,250	2,000	3,250	3,140	9,903,310
Sub-Total	236,379	29,000	207,379	163,962	772,477,845
Less: Reservation by North Platte Project for use in Nebraska	- 700			- 700	- 3,074,960
Total	235,679 kw.	29,000 kw.	206,679 kw.	163,262	769,402,885
Less: 1941 peak for area			163,262	(Note * See Par. 2)	
Surplus Capacity in area			43,417 kw.		

5. In Area I the interconnection of the following systems with the present system can be economically justified with a net surplus capacity in the amounts indicated.

TABLE I-B

	Dependable Capacity	1941 Peak Demands	Surplus Capacity
Fort Collins	7,000 kw.	2,750 kw.	4,250 kw.
Longmont & Lyons	3,402 kw.	1,938 kw.	1,464 kw.

This makes a total surplus capacity in these three systems of 5,714 kw. which, if the plants were interconnected, could be added to the available surplus capacity of the present system because these systems could rely on the reserve of the entire interconnected system of Area I.

6. The cost, amount of copper, and time required for the accomplishment of the above interconnections are approximately as follows:

TABLE I-C

Interconnection	Cost	Pounds of Copper	Time Required
Fort Collins	$110,000	34,500	60 days
Longmont & Lyons	10,000	400	60 days

7. In Area I there are a number of plants that are not interconnected with the systems in Area I which have not been considered as susceptible of interconnection because the distance from existing transmission lines would make such interconnection infeasible. The plants that are thus considered are as follows:

Isolated but Adjacent (within 15 miles)	Installed Capacity-KW
Mountain Utilities Corp., Elizabeth, Colo. Division	170
Mountain Utilities Corp., Aspen, Colorado Division	800
Eagle River Electric Company, Eagle, Colorado	373
Medicine Bow Electric Co., Medicine Bow, Wyoming	150
North Albany Light & Power Co., Rock River, Wyoming	42
Hudson Light & Power Company, Hudson, Wyoming	35
Meeteetse Light Company, Meeteetse, Wyoming	37
Wind River Indian Agency, Fort Washakie, Wyoming	95
Orchard, Colorado	32

Isolated (over 15 and under 30 miles)	
J. W. Harvey, Burns, Wyoming	64
Commonwealth Utilities Corp., Akron, Colorado System	420
Chugwater, Wyoming	64
Union Pacific Coal Company, Hanna, Wyoming	2,500
Plateau Valley Light & Power Co., Collbran, Colorado	130
PineBluffs Light, Water, & Power Co., PineBluffs, Wyoming	420
Fleming, Colorado	92
Crook, Colorado	38
Ten Sleep Electric Light & Power Co., Ten Sleep, Wyoming	15
Meeker, Colorado	500

8. Generating plants of over 1,000 kw. dependable capacity each and located over 30 miles from the present interconnected system of Area I have been considered and eliminated as not justified for interconnection at this time, due to the amount of critical material required. These systems are as follows:

Union Pacific Coal Co., Rock Springs, Wyoming	20,000 kw.
Utah Power & Light Co., Green River, Wyoming	1,240 kw.
Sheridan County Electric Co., Sheridan, Wyoming	6,000 kw.
Lincoln Service Corp., Frontier, Wyoming	5,500 kw.
Diamond Coal & Coke Co., Diamondville, Wyoming	1,000 kw.
Colorado Utilities Corp., Steamboat Springs, Colo.	3,438 kw.
Moffat Coal Company, Oak Creek, Colorado	1,650 kw.

9. The following industrial plants of over 1,000 kw. dependable capacity were considered and eliminated as possible sources of surplus capacity because their entire capacity is required for their own load-(and, in the case of the Denver Tramway Corporation, frequency conversion is necessary):

The Denver Tramway Corporation, Denver, Colorado
Colorado Portland Cement Co., La Porte, Colorado
Gates Rubber Company, Denver, Colorado
Du Pont, E.I. de Nemours & Co., Inc., Louviers, Colorado
Sinclair Refining Company, Parco, Wyoming
Continental Oil Company, Glenrock, Wyoming

Emergency conditions may make desirable a detailed consideration of the surplus capacity from these sources.

10. With the feasible interconnections that have been suggested above, the amount of power that could be made available for use in Area I will be materially increased.

11. The addition of transmission facilities from Valmont to Denver via Fort Lupton and from Fort Lupton to Greeley will increase the amount of surplus capacity available at load center. The increase of the transmission facilities from Valmont to Denver via Fort Lupton can be accomplished by the building of a second line from the Valmont plant to Denver, the expense of which is shown in Table I-E. This is made extremely desirable, if not absolutely necessary, because of the heavy and exacting requirements of the chemical warfare plant. Should the growth in load be at Greeley or north of Greeley, an increased capacity at that location can be obtained by building a tap from the Denver-Valmont line to Greeley.

12. The following table shows the cost, the amount of copper, and the time required for installation of the additional transmission facilities:

TABLE I-E

Facilities	Cost	Pounds of Copper	Time Required
Valmont to Denver line	$370,000	300,000	6 months
Above line to Greeley	$126,000	120,000	3 months

13. The additional capacities that could be economically installed in Area I would be:

Rewinding and reblading the No. 1 Unit at the Valmont Plant of the Public Service Company, which now has a nominal rated capacity of 20,000 kw. at 80% power factor. The rewinding would increase this nominal rating to 30,000 kw., which would give a net dependable capacity of 32,250 kw. The cost of rewinding would be approximately $238,000, or about $24 per kw. for increasing the capacity of the unit. This should be accomplished and the unit ready for production not later than April 1, 1943.

There has been under consideration the installation of an additional 50,000 kw. turbo-generator unit in the Valmont plant of the Public Service Company of Colorado, at an expense of $4,000,000, as and when the developing demands indicate the necessity for it. This 50,000 kw. unit would have a dependable capacity of 50,000 kw. at 80% power factor, or 56,250 kw. at 90% power factor. The unit could be installed in approximately 27 months after placing the order. The cost of generation of this unit at 100% load factor would be 2.35 mills per kwh. and at 60% load factor it would be 2.96 mills. Those production estimates include 10% of the capital investment as annual overhead.

The installation of a 2,500 kw. steam unit at Fort Morgan, Colorado, to be in service May 1, 1945.

14. The United States Bureau of Reclamation in its Colorado - Big Thompson project, which is now under construction, plans for the building of the following plants:

TABLE I-F

Plant	Installed Capacity KVA	Date of Expected Completion
Plant No. 1	60,000	May 1, 1944
Plant No. 1A	8,000	May 1, 1944
Plant No. 2	56,000	May 1, 1944
Plant No. 3	13,000	May 1, 1945
Plant No. 4	16,000	May 1, 1945
Plant No. 4A	7,000	May 1, 1945
Plant No. 5	24,000	May 1, 1943
Total	184,000	

14a The Colorado-Big Thompson project consists of three reservoirs, two collection canals, one power plant, one pumping plant and canal on the Western Slope. The power plant is No. 5 in the above tabulation and is known as the Green Mountain plant and is located on the Blue River in the vicinity of Kremmling. It is contemplated that this plant will be put into service by May 1, 1943. It will have a generating capacity of 21,600 kw. During the first year of operation it is intended that the output of the plant will not be materially in excess of 30,000,000 kwh., and it is not considered advisable to take the full capacity, as dictated by the flow of water in the Blue River, during the first year. It will, however, during that year be used as a peaking plant and will carry its full capacity for short periods of time each day as required.

14b Of the proposed plants of the Colorado-Big Thompson on the Eastern Slope, plants Nos. 1, 1a, and 2, having an aggregate dependable capacity of 111,600 kw., are due for completion by May 1, 1944, and plants Nos. 3, 4, and 4a, having an aggregate dependable capacity of 24,860 kw. are due for completion by May 1, 1945. The keeping of these dates is all dependent upon the due completion of the Granby Reservoir, which is located just west of the tunnel going through the Continental Divide. This reservoir furnishes storage capacity necessary

for the uniform flow of water through the tunnel, permitting the plants on the Eastern Slope to take their portion of the load. In this study, complete dependence is placed upon the date set for the completion of the Green Mountain plant of the Colorado Big-Thompson on May 1, 1943. It is also important that Granby Reservoir be completed in order to permit the use of one or all the three plants due for completion May 1, 1944.

15. With the interconnection of the Fort Collins and Longmont - Lyons systems described in Paragraph 5, and with the addition of the estimated net power obligations for 1942, to the peak of 1941, conditions as of January 1, 1943 are obtained. Adding new generating capacities and the estimated net power obligations to the conditions as of January 1, 1943, conditions as of January 1, 1944 are obtained. These loads are applied to the available capacities in Tables I-H and I-J.

TABLE I-G

EXPECTED INCREASES IN LOAD OF AREA I

	Commitments for 1942 over 1941	Commitments for 1943 over 1942
Load increases over 1,000 kw.		
At Denver:		
Buckley Field	1,000 kw.	
Ordnance Plant	3,000	1,000 kw.
Lowry Field	1,000	
Chemical Warfare Plant	1,500	28,500
At Leadville:		
Climax Molybdenum Co.	1,500	
Pando Training Area	1,500	
At Cheyenne:		
Air Assembly Plant	1,000	
At Casper:		
Bombing Cantonment	1,000	
Total increase in large loads	11,500	29,500
Normal load increases under 1,000 kw.	7,950	7,250
Total increase in area loads	19,450	36,750

TABLE I-G
(continued)

Load losses:		
Due to industrial dislocation, etc.	500	1,500
Suspension of dredge operations	1,000	
Construction completed at Denver Ordnance Plant	750	
Caused by daylight saving	3,500	250
Total decrease in loads	5,750	1,750
Diversified effect of above changes in area loads - Coincidental demand		
Increase in large loads	10,400	25,800
Normal increase in small loads	7,950	7,250
Total increase	18,350	33,050
Decrease in all loads	5,750	1,750
Net additional increase in area	12,600 kw.	31,300 kw.

TABLE I-H

	Dependable Capacity	Peaks	Reserve	Surplus
1/1/42 conditions	235,679 kw.	163,262	29,000	43,417
Removal of 1-unit at Stanolind	-12,500			
Interconnection of Fort Collins, Longmont, etc.	10,402	4,688		
Net additional load obligations		12,600		
1/1/43 conditions	233,581	180,550	29,000	24,031

16. During 1943 the rewinding and reblading of turbine No. 1 in the Valmont plant of the Public Service Company, described in paragraph 13, will be accomplished, and the Green Mountain power plant of the United States Bureau of Reclamation, described in paragraph 14a, will be put into service, which additional sources, together with changes in load obligations during 1943, would yield conditions as of January 1, 1944, approximately as follows:

TABLE I-J

	Dependable Capacity	Peaks	Reserve	Surplus
1/1/43 conditions	233,561 kw.	180,550	29,000	24,031
Rewinding No. 1 turbine	10,000			
Green Mountain Unit	21,600			
Net additional load obligations		31,300		
1/1/44 conditions	265,181	211,850	32,250	21,031

17. The 1944 reserve of 32,250 kw. is the reserve made necessary by the additional capacity of turbo-unit No. 1 in the Valmont generating station.

18. In arriving at the area surplus capacity, from the total dependable capacity have been deducted the annual peaks and the estimated reserve required for the area. There is no question but that maintenance, overhauling, and repair, in most instances, can be arranged so that machines will be out of service only during the months of light load; thus enabling the utilization during the peak months, without undue risk, of a surplus which would be the sum of the area reserve plus the surplus capacity arrived at as above.

19. The amount of energy that was available during the December, 1941 peak, with all generating capacity operating, for the various load centers was as follows:

ELECTRIC POWER AVAILABLE FOR ADDITIONAL LOAD AT VARIOUS LOAD CENTERS IN AREA NO. 1 DURING DECEMBER, 1941 WITH ALL GENERATING CAPACITY OPERATING

Condition No. 1	Power Available for Additional Load Unprotected by Reserve Supply
Load Center	
Surplus capacity including plants now interconnected and with existing transmission facilities (excludes Fort Collins, Longmont, Lyons, and Sterling-Brush systems)	
Casper	8,900 kw.
Cheyenne	17,400 kw.
Greeley	17,400 kw.
Denver	53,800 kw.
Leadville	19,500 kw.
Grand Junction	4,000 kw.

Commitments have been made that produce certain expectancies in loads and these are shown on Table I-G of this report. These increased expectancies in load are made with the best judgment that can be exercised, but at best they are estimates. When applied to the load centers, taking into consideration additional transmission facilities, consisting of the construction of the new Valmont-Denver-Lupton 110 kv. line and the increased generating capacity by the rewinding and reblading of Valmont generator No. 1 and the interconnection of Fort Collins, Longmont, Lyons, and Sterling-Brush, but not considering the additional capacity of Green Mountain, the surplus conditions would be as follows:

ELECTRIC POWER AVAILABLE FOR ADDITIONAL LOAD AT VARIOUS LOAD CENTERS IN AREA NO. I DURING DECEMBER, 1943 WITH ALL GENERATING CAPACITY OPERATING

Condition No. 2	Power Available for Additional Load Unprotected by Reserve Supply
Load Center	
Surplus Capacity After Completion of Valmont #1 Rewind; Construction of New Valmont-Denver-Lupton 110 KV Line;	

Condition No. 2 (continued)

Load Center

and Interconnection of Fort Collins,
Longmont, Lyons, and Sterling-Brush
to the System, but without the Green
Mountain Plant

Casper	6,700 kw.
Cheyenne	6,700 kw.
Greeley	6,700 kw.
Denver	6,700 kw.
Leadville	6.700 kw.
Grand Junction	2,800 kw.

With the addition to the above situation of the Green Mountain Plant of 21,600 kw. capacity the following conditions would exist:

Condition No. 3

Casper	6.700 kw.
Cheyenne	28,300 kw.
Greeley	28,300 kw.
Denver	28,300 kw..
Leadville	28,300 kw.
Grand Junction	2,800 kw.

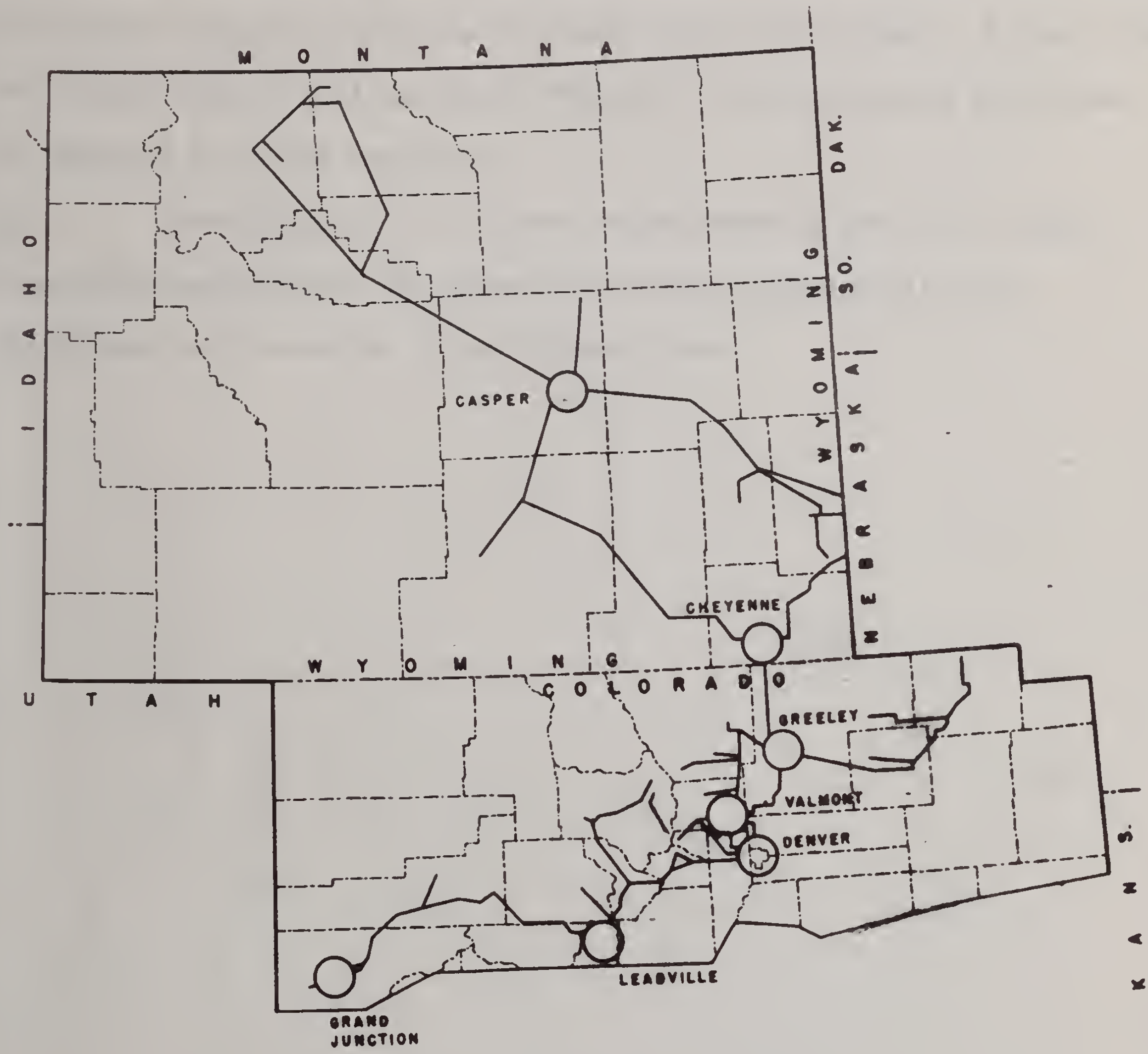
The value at load center simply indicates capacity of transmission facilities to serve that load center under conditions stipulated and at all times is limited by the commitments to other load centers and by available generating capacity.

20. Load centers have been arbitrarily chosen but indicate the amount of power that could be delivered in that particular region. Their location is clearly shown on Drawing I-a.

COLORADO WATER CONSERVATION BOARD
CLIFFORD H. STONE Director, C.L. PATTERSON Chief Engineer, R.J. TIPTON and H.S. SANDS Consulting Engineers.

AREA I

LOCATION OF LOAD CENTERS CONSIDERED



DRAWING I-a

[illegible]

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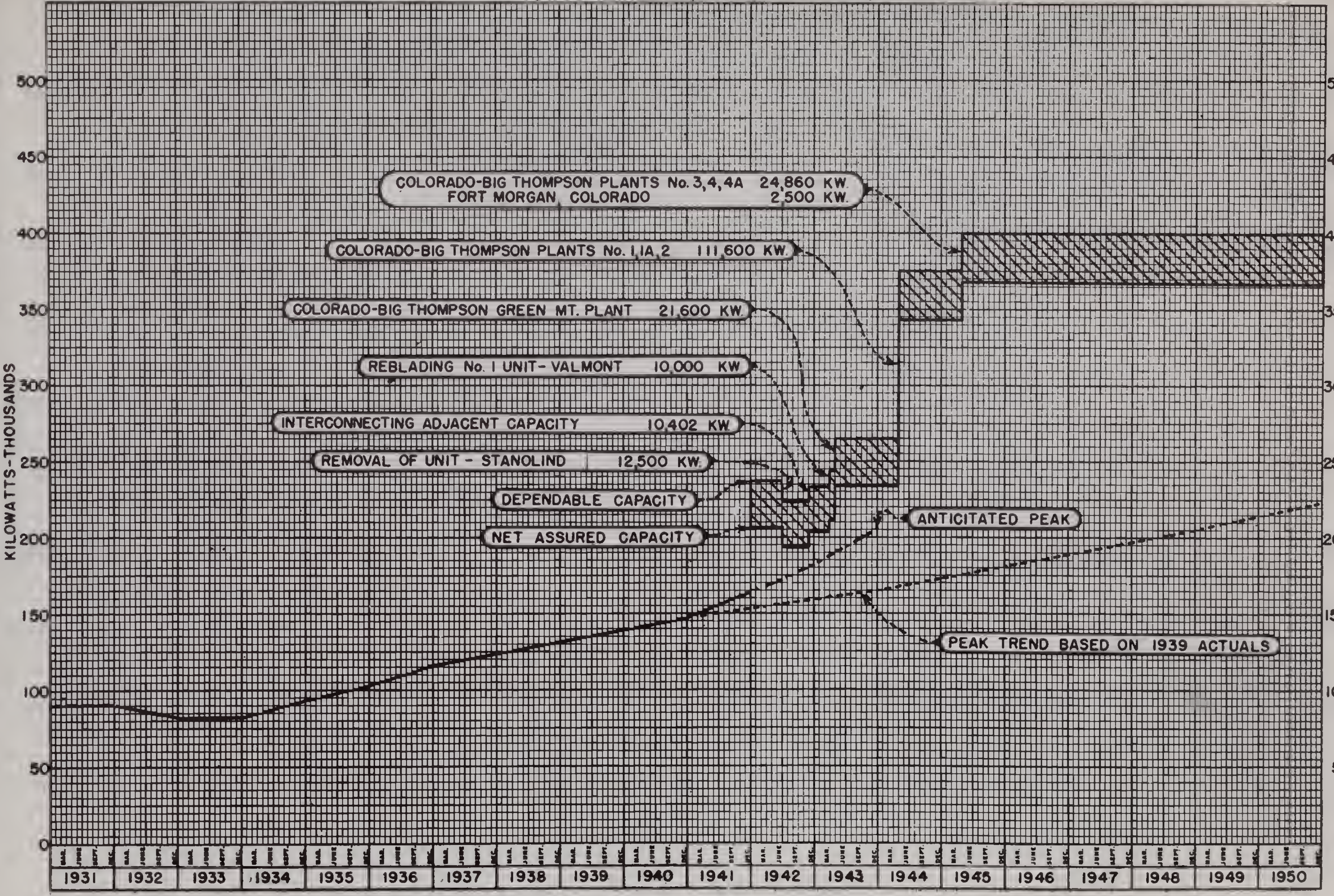
21. Drawing No. I-b is a chart which shows, by years, the dependable capacity and net assured capacity of the system not including the 50,000 kw. unit suggested for the Valmont plant. It also shows the actual non-simultaneous peak of the entire system up until 1941 and the expected peaks, as estimated in 1939 by the major utilities, from 1939 to 1949, in which no war loads were contemplated. It also shows the actual peak of 1941 and the difference between estimated and actual is presumed to be the war load.

22. Drawing No. I-c is a chart which shows by years the system dependable capacity and the system net assured capacity with the 50,000 kw. unit installed in the Valmont plant.

COLORADO WATER CONSERVATION BOARD — CLIFFORD H. STONE, Director C.L. PATTERSON, Chief Engineer R.J. TIPTON, Consulting Engineer



PEAKS AND CAPACITIES OF POWER SYSTEMS
AREA I
(ANNUAL PEAKS SHOWN AT END OF YEAR)
HERBERT S. SANDS, CONSULTING ENGINEER

DRAWING I - b

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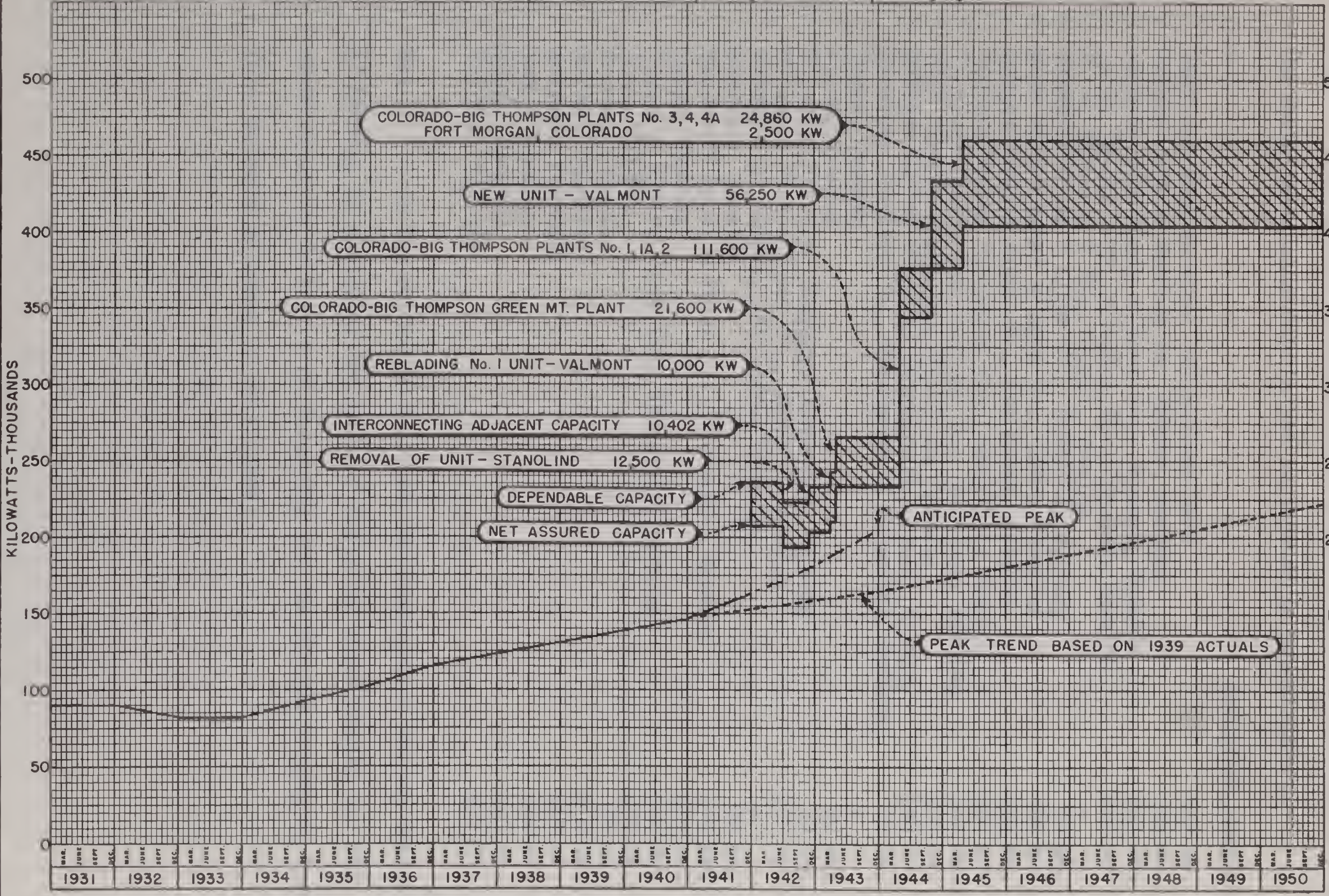

PEAKS AND CAPACITIES OF POWER SYSTEMS
AREA I
(ANNUAL PEAKS SHOWN AT END OF YEAR)
HERBERT S. SANDS, CONSULTING ENGINEER

DRAWING I - c

23. Isolated plants (over 30 miles from interconnected systems) in which interconnection is not considered as practicable -

	Installed Capacity
National Park Service, Yellowstone Park	730 kw.
Dubois Public Service Co., Dubois, Wyoming	188 kw.
Jackson Hole Light & Power Co., Jackson, Wyoming	327 kw.
Lower Valley Power & Light, Inc. Freedom, Wyoming	480 kw.
D. A. Blackmon & Son, Daniel, Wyoming	-
Pinedale Power & Light Co., Pinedale, Wyoming	30 kw.
Star Valley Power & Light Co., Afton, Wyoming	880 kw.
Griggs Power & Light Co., Big Piney, Wyoming	124 kw.
Western States Utilities Co., Cokeville, Wyoming	180 kw.
Saratoga Light, Heat & Power Co., Saratoga, Wyoming	182 kw.
Utah Power & Light Co., Evanston, Wyoming	550 kw.
Bridger Valley Electric Association, Lyman, Wyoming	180 kw.
Parkison Electric Co., Encampment & Riverside, Wyoming	32 kw.
Baggs, Wyoming	-
Dixon, Wyoming	20 kw.
Shickley Electric Company, Clearmont, Wyoming	50 kw.
Mountain States Power Co., Buffalo, Wyoming	700 kw.
Wyodak Coal Company, Gillette, Wyoming	-
Sundance, Wyoming	70 kw.
Moorcroft Light & Power Co., Moorcroft, Wyoming	100 kw.
Upton, Wyoming	125 kw.
Mountain States Power Co., Newcastle, Wyoming	616 kw.
Lusk, Wyoming	435 kw.
Grover, Colorado	36 kw.
Walden, Colorado	218 kw.
Holyoke, Colorado	535 kw.
Yuma, Colorado	480 kw.
Wray, Colorado	425 kw.
Haxtun, Colorado	420 kw.

24. In the report of Mr. Gustavus Sessinghaus, Mining Engineer of Denver, he placed an estimate of the power requirements for the seven counties in Area I in Colorado, and for Natrona County in Wyoming. This estimate of power is as follows:

SUMMARY OF APPROXIMATE POWER REQUIREMENT

	Coincidental Daily Demand in KW on Utility Systems
Colorado	
Boulder County	80
Clear Creek County	
Idaho Springs	400
Georgetown & Silver Plume	533
Urad	374
Gilpin County	
Central City	462
Summit County	
Montezuma	226
Ten Mile	485
Breckenridge	112
Park County	
Alma	200
Eagle County	
Red Cliff	746
Lake County	
Leadville	312
Wyoming	
Casper Mountain	560

The necessary power for these operations can be made available from adjacent lines.

CONCLUSIONS:

A. Additional transmission facilities are necessary in order to take care of the power commitments and early and serious consideration should be given to the installation of the Denver-Valmont line to be completed not later than August 1, 1943. (Paragraphs 11 and 12)

B. Definite consideration should be given to the interconnection of the systems at Fort Collins and Longmont, both of these to be accomplished in 1942. (Paragraphs 5 and 6)

CONCLUSIONS: (continued)

C. The Green Mountain plant of the Colorado-Big Thompson will come into service May 1, 1943. (Paragraph 14a)

D. It is most important that the rewinding of the No. 1 unit of the Valmont steam plant of the Public Service Company should be accomplished as expeditiously as possible. (Paragraph 13)

E. With these installations made, at the end of 1943, or by January 1, 1944, there will be available 17,896 kw. of surplus, which added to 32,250 kw. of reserve, will make a total available of 50,146 kw. after all presently known commitments are provided for.

F. Should unforseen loads develop in the area north of Denver, it may be necessary to build the Valmont-Fort Lupton-Greeley tie. (Paragraphs 11 and 12)

G. In the spring of 1944 the No. 1, No. 1a, and No. 2 plants of the Colorado-Big Thompson, or part of them, are expected to come into service. (Paragraph 14b)

H. There are now no present or discernible demands, so far as Area I is concerned, that would justify the installation of the additional 50,000 kw. unit at Valmont, or of additional capacity elsewhere in the area. (Paragraph 13)

ANALYSIS OF THE POWER SYSTEMS
IN COLORADO SPRINGS, COLORADO, AND EAST
DESIGNATED AS AREA II

BEING A PART OF THE ANALYSIS
OF ELECTRIC POWER
REQUIRED AND AVAILABLE
IN COLORADO AND WYOMING

AREA II

1. The principal generating and distribution system of Area II is that belonging to the City of Colorado Springs. Colorado Springs is 71 miles south of Denver and is located in El Paso County, Colorado. It obtains its principal load from the immediate vicinity of Colorado Springs, although it does distribute so far as Larkspur on the north, Fountain on the south, Woodland Park on the west, and Limon on the east.

2. As of January 1, 1942, it was interconnected with the Town of Limon served by the Commonwealth Utilities Corporation. The following is a statement of their dependable capacity, reserves, net assured capacity, peaks, and kilowatthour output for 1941.

TABLE II-A

LOAD AND SUPPLY DATA FOR INTERCONNECTED POWER SYSTEMS IN AREA II

Capacities as of January 1, 1942

	Dependable Capacity	Reserves	Net Assured Capacity	1941 Peak KW	1941 Loads KWH
Colorado Springs, Colorado	16,000 kw.	5,000 kw.	11,000 kw.	9,700	34,797,460
Commonwealth Utilities Corp. Limon System	386	250	136	0	0
Total	16,386 kw.	5,000 kw.	11,386 kw.	9,700	34,797,460
Less 1941 peak			9,700		
Surplus Capacity			1,686 kw.		

3. There are several plants not interconnected with the Colorado Springs system within an area of 15 miles. These are as follows:

	Dependable Capacity	Reserves	Net Assured Capacity	1941 Peak KW	1941 Loads KWH
Inland Utilities Co., Stratton	576 kw.	240 kw.	336 kw.	335	1,062,000
Flagler, Colorado (Municipal)	150	110	40	80	244,500
Burlington, Colo.	502	250	252	265	817,000
Total	1,228	600	628	680	2,123,500

4. The Inland Utilities Company furnishes service to Stratton, Hugo, and Arriba. With generating plants at Hugo and Stratton they have a net assured capacity of 336 kw. Flagler is not interconnected with the system of the Inland Utilities Company and has a net assured capacity of 40 kw. Burlington is about 12 miles from Stratton and has a net assured capacity of 252 kw. It is estimated that it would cost about $40,000 to build a line from Hugo to Genoa, and a line from Stratton to Burlington. It is very questionable whether these interconnections would be of sufficient advantage to justify these extensions.

5. Since January 1, 1942, the City of Colorado Springs has under-taken the addition to its system of one boiler which will add 2,000 kw. to the total capacity and will be available for service by October 1, 1942. The city has also entered into a contract with the Golden Cycle Mining Company, with which its system is interconnected, for the purchase of 1,500 kw. of firm/steam energy and 2,500 kw. for use at evening peak. This will be available for service on September 1, 1942.

6. The city has firm commitments to supply Camp Carson with 5,000 kw. and the government air school with 750 kw. These with otheradditions and deductions appear in Table II-G which shows the net increase in load in the area during 1942 to be 6,050 kw. and in 1943 to be 700 kw.

TABLE II-G

EXPECTED INCREASE IN LOAD OF AREA II

	Commitments for 1942 over 1941	Commitments for 1943 over 1942
Increase in large loads		
At Colorado Springs:		
Camp Carson	5,000 kw.	
Air School	750	
Total increase in large loads	5,750	
Normal increase in small loads	800	800 kw.
Total increase in area loads	6,550	800
Load losses:		
Due to industrial dislocation, etc.	100	100
Caused by daylight saving	250	
Total decrease in load	350	100
Diversified effect of above changes in area loads Coincidental demand		
Increase in large load	5,600	
Normal increase in small loads	800	800
Total increase	6,400	800
Decrease in all loads	350	100
Net additional increase in area	6,050 kw.	700 kw.

7. These values are incorporated in Tables II-H and II-J which show estimated conditions for January 1, 1943 and January 1, 1944 as follows:

TABLE II-H

	Dependable Capacity	Peaks	Reserve	Surplus
1/1/42 conditions	16,386 kw.	9,700 kw.	5,000 kw.	1,686 kw.
Purchase of firm capacity from Golden Cycle mill	2,500			
Installation of new boiler	2,000			
Net additional load obligations		6,050		
1/1/43 conditions	20,886 kw.	15,750 kw.	5,000 kw.	136 kw.

TABLE II-J

	Dependable Capacity	Peaks	Reserve	Surplus
1/1/43 conditions	20,886 kw.	15,750 kw.	5,000 kw.	136 kw.
Net additional load obligations		700		
1/1/44 conditions	20,886 kw.	16,450 kw.	5,000 kw.	- 564 kw.

8. The principal and dominant load center is Colorado Springs and adjacent territory as shown in Drawing II-a. There will be available, therefore, for this load center on January 1, 1943 5,136 kw.; on January 1, 1944 there will be 4,436 kw., allowing no reserve in each instance.

9. It is probable that further arrangements could be made with the Golden Cycle Mining Company, whereby it would furnish an additional 2,500 kw. This would require additional boiler capacity on its part and an increase in capacity of the interconnection facilities which are now planned for only 2,500 kw.

10. The town of Limon, which is shown in Table II-a, has a total generating capacity of 386 kw. This is connected to the transmission line from the City of Colorado Springs to Limon and is now shut down. The full benefit of this capacity could be obtained during the peak periods by operating this plant for one or two hours a day for three winter months.

11. Of the total dependable capacity which Colorado Springs will have on January 1, 1943, 14,500 kw. will be in steam generators, 6,000 kw. will be in hydro plants, and 366 kw. located in Limon will be produced by internal conbustion engine.

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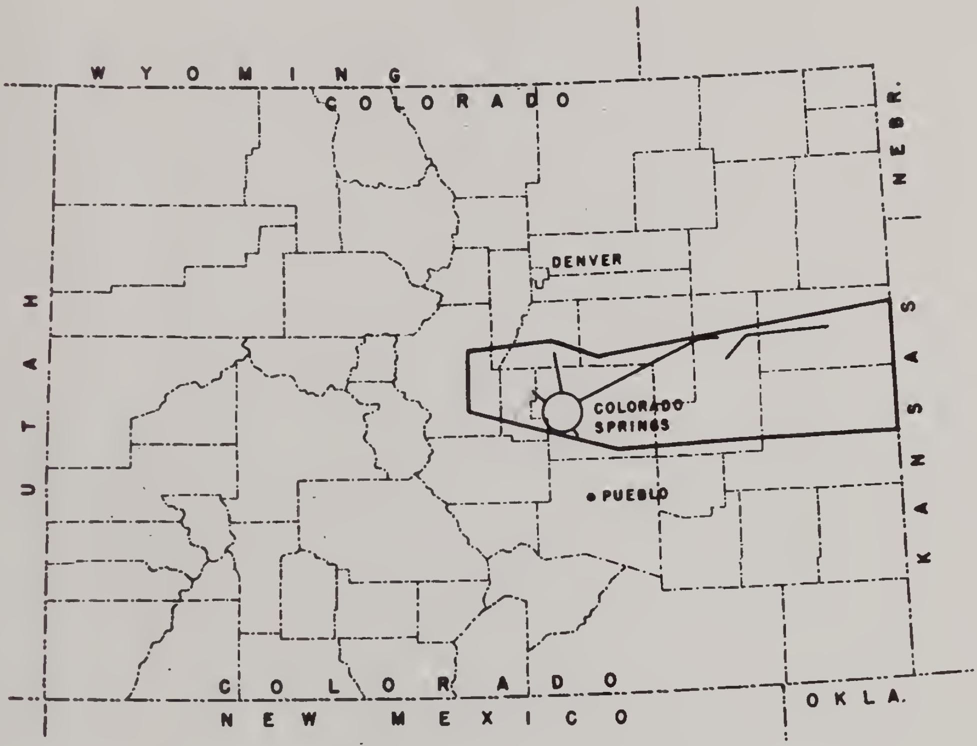
CLIFFORD H. STONE Director, C.L. PATTERSON Chief Engineer, R.J. TIPTON and H.S. SANDS Consulting Engineers.

AREA II

LOCATION OF LOAD CENTERS CONSIDERED



DRAWING II-a

12. Drawing No. II-b shows the actual annual peak for 1941 and the expected peaks for 1942 and 1943 together with their relation to the dependable capacity and the net assured capacity.

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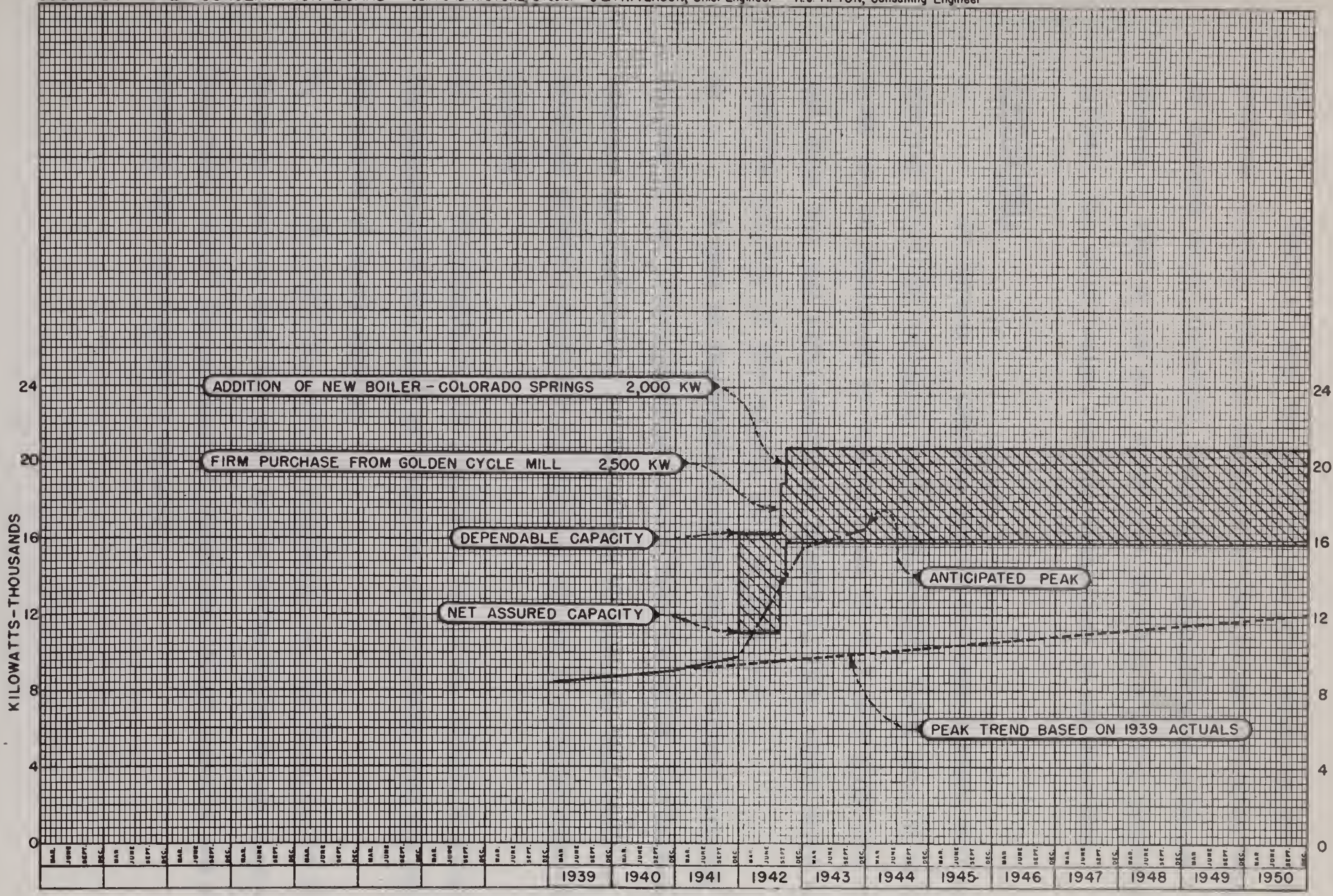


PEAKS AND CAPACITIES OF POWER SYSTEMS
AREA II
(ANNUAL PEAKS SHOWN AT END OF YEAR)
HERBERT S. SANDS, CONSULTING ENGINEER

DRAWING II-b

[illegible]

13. There is only one plant in this area which has not received previous mention. This is the plant of the Inland Utilities Company at Cheyenne Wells, Colorado, which had a generating capacity as of January 1, 1942 of 308 kw. It is over 30 miles from the interconnected systems, for which reason its interconnection is not feasible.

CONCLUSIONS:

A. On January 1, 1943 the City of Colorado Springs will have over and above the estimated load requirements, 5,136 kw., of which 5,000 kw. is considered as reserve; and it will have 4,436 kw. over and above the load requirements of January 1, 1944, which would be less than the capacity of the largest unit of 5,000 kw.

B. A gain in dependable capacity and net assured capacity can be made by the interconnection between Hugo and Genoa, and between Stratton and Burlington, but the amount of capacity that would be acquired probably would not justify the amount of critical material required.

C. Consideration, if conditions demand it, should be given to the operation of the plant at Limon for short periods each day during the months of heavy demands.

D. If conditions make it necessary, an additional 2,500 kw. might be obtained from the plant of the Golden Cycle Mining Company. This would entail the purchase of additional boiler capacity and remodeling the interconnection capacity.

ANALYSIS OF THE POWER SYSTEMS
IN ARKANSAS VALLEY, COLORADO
DESIGNATED AS AREA III

BEING A PART OF THE ANALYSIS
OF ELECTRIC POWER
REQUIRED AND AVAILABLE
IN COLORADO AND WYOMING

AREA III

1. This area includes the systems of the Southern Colorado Power Company, the Inland Utilities Company (Holly Division), and the municipal plants at La Junta, Lamar, and Las Animas. The principal city in the area is Pueblo, located in the center of Pueblo County, which is an important industrial center. The principal industry is that of the Colorado Fuel & Iron Corporation. Pueblo is served by the Southern Colorado Power Company with plants at Pueblo, Skaguay, and Canon City. This Company serves the entire Canon City district and its lines run down the valley of the Arkansas River as far as the eastern county line of Otero County. As of January 1, 1942, the Southern Colorado Power Company was operating interconnected with the plant at Las Animas. The municipal plant at Lamar operates interconnected with the Holly plant of the Inland Utilities Company which plant has not been operating.

2. The discussion of Area III will be in two parts; one part covering the Southern Colorado Power Company system and the plants at Las Animas and La Junta, and the second part covering the Lamar-Inland Utilities Company system.

PART ONE

3. Conditions of the system of the Southern Colorado Power Company on January 1, 1942 are shown in Table III-A.

TABLE III-A

LOAD AND SUPPLY DATA FOR INTERCONNECTED SYSTEM OF SOUTHERN COLORADO POWER COMPANY

Capacities as of January 1, 1942

	Dependable Capacity	Re-serves	Net Assured Capacity	1941 Peak KW	1941 Loads KWH
So. Colo. Power Co.					
Pueblo Plant	23,190 kw.	9,215 kw.	13,975 kw.	13,450)	
Canon City Plant	12,185	9,285	2,900	6,390)	91,770,290
Skaguay Plant	1,000	250	750	1,450)	
Las Animas, Colo.	520	260	260	435	28,350
Total	36,895 kw.	9,285 kw.	27,610 kw.	21,725	91,798,640
Less 1941 peak			21,725		
Surplus Capacity			5,885 kw.		

4. The increase in load expected to result from commitments for 1942 and 1943 is shown in Table III-G. This table also shows the load losses which are estimated for both those years.

TABLE III-G

EXPECTED INCREASE IN LOAD OF AREA III

	Commitments for 1942 over 1941	Commitments for 1943 over 1942
Increase in large loads		
At Pueblo		
Air Base	1,500 kw.	
Ordnance depot	1,000	
At La Junta		
Air Base	1,000	
Total increase in large loads	3,500	
Normal increase in small loads	1,000	500 kw.
Total increase in area loads	4,500	500
Load losses:		
Due to industrial dislocation	200	100
Caused by daylight saving	500	100
Total losses in area load	700	200

TABLE III-G

EXPECTED INCREASE IN LOAD OF AREA III

(continued)

Diversified effect of above changes in area loads - Coincidental demand		
Increase in large loads	3,200	
Normal increase in small loads	1,000	500
Total increase in area loads	4,200	500
Decrease in all loads	700	200
Net additional increase in area	3,500 kw.	300 kw.

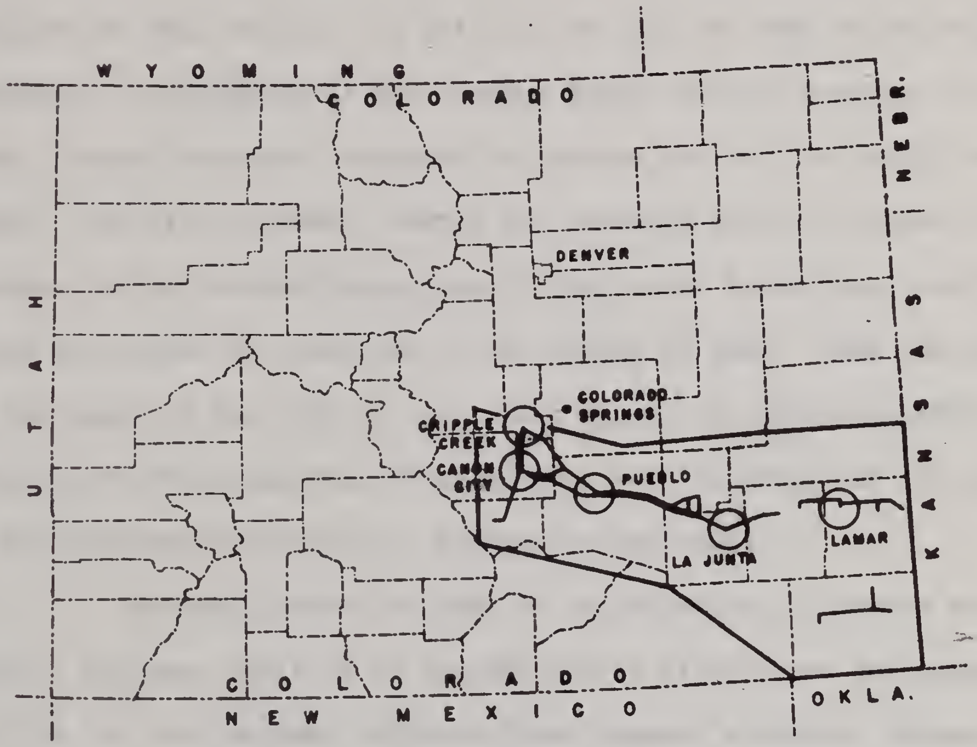
5. Drawing III-a shows the location of load centers which have been arbitrarily selected. The kilowatts available at each of these load centers for loads over and above 1941 peak values are as follows:

Pueblo	5,000 kw.
Canon City	5,000 kw.
Cripple Creek	2,000 kw.
La Junta	3,000 kw.

The value at the load center simply indicates the capacity of transmission facilities to serve that load center and is limited by the commitments to other centers and by available generating capacity.

AREA III

LOCATION OF LOAD CENTERS CONSIDERED



DRAWING III-a

6. Until the fall of 1941 the City of Las Animas was served by the Western Public Service Company, which had a plant with a dependable capacity of 520 kw., and the peak on the system was 435 kw. in 1941. The Western Public Service Company also was connected with the transmission line of the Southern Colorado Power Company. This connection was made at the county line between Bent and Otero Counties, the Western Public Service Company owning the line from Las Animas to the western boundary of Bent County. In the fall of 1941 the City of Las Animas purchased the property of the Western Public Service Company including their transmission and distribution systems but not including their power plant. The city, however, rented and operated the power plant of the Western Public Service Company until they could build their own plant, which was placed in operation in the spring of 1942. When the operation of the plant of the City of Las Animas began, the interconnection made with the Southern Colorado Power Company was not used, and the plant of the Western Public Service Company became idle.

7. Presuming that the City of Las Animas will operate throughout 1942 on the same basis as at present, Table III-H shows the probable surplus for the Southern Colorado Power Company system on January 1, 1943.

TABLE III-H

	Dependable Capacity	Peaks	Reserve	Surplus
1/1/42 conditions	36,895 kw.	21,725	9,285	5,885
Loss of Las Animas	- 520	- 435		
Net additional load obligations		3,500		
1/1/43 conditions	36,375	24,790	9,285	2,300

8. The new municipal plant at Las Animas has a dependable capacity of 618 kw. The Las Animas system could again be interconnected

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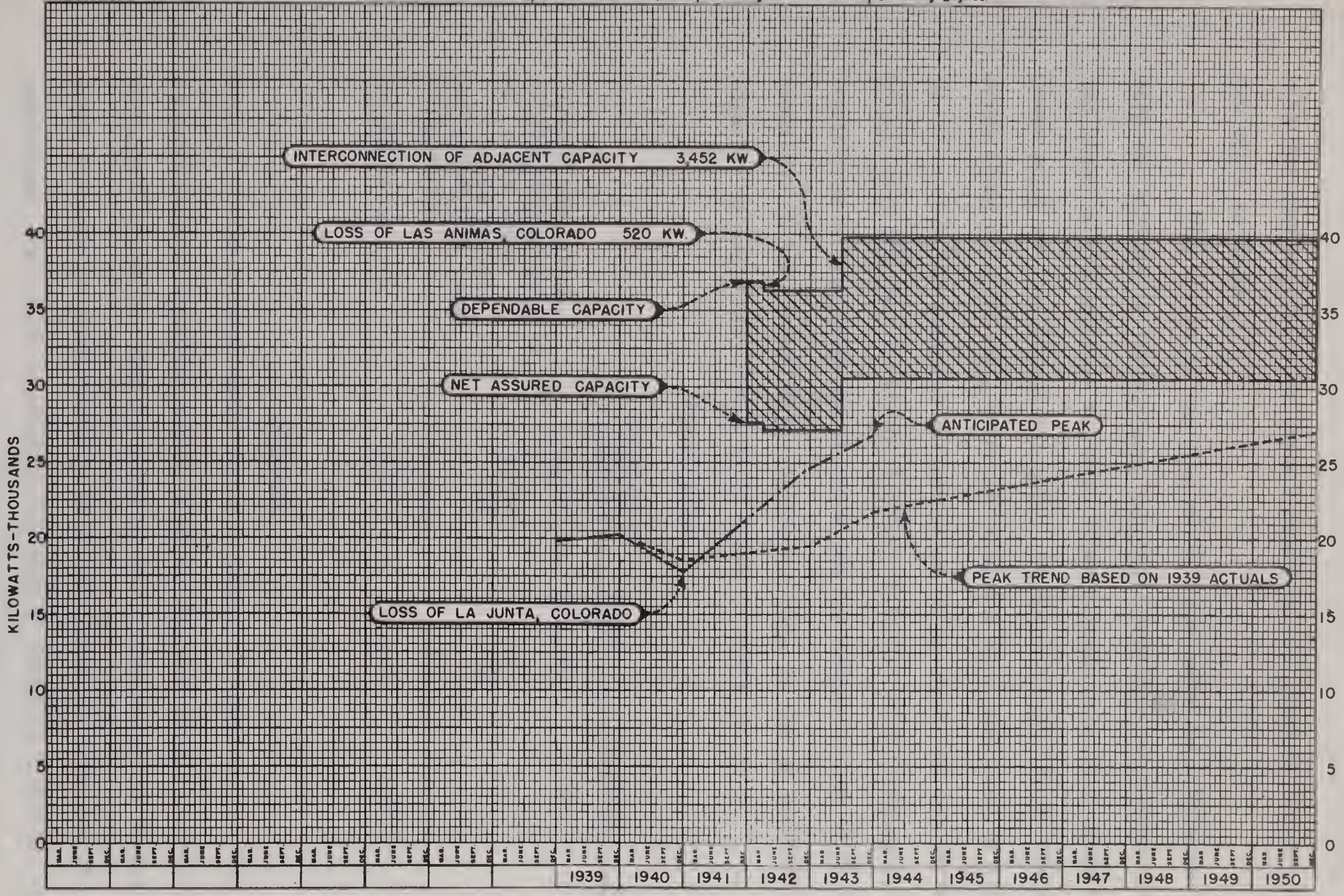

PEAKS AND CAPACITIES OF POWER SYSTEMS
AREA III
(ANNUAL PEAKS SHOWN AT END OF YEAR)
HERBERT S. SANDS, CONSULTING ENGINEER

DRAWING III-b

with the Southern Colorado Power Company as the lines of the two systems are still adjacent.

The system of the City of La Junta could be interconnected with the systems of the Southern Colorado Power Company rather simply as the lines of the Southern Colorado Power Company pass very close to the power plant of the City of La Junta. Dependable capacity of the La Junta plant is 2,834 kw., which supplied the 1941 peak load of 1,420 kw.

9. If the reserves of the cities of La Junta and Las Animas were pooled with the reserve of the Southern Colorado Power Company by interconnection of the plants at La Junta and Las Animas during 1943, the condition of the system as of January 1, 1944, so far as surplus capacity is concerned, would be as shown in Table III-J.

TABLE III-J

	Dependable Capacity	Peaks	Reserve	Surplus
1/1/43 conditions	36,375 kw.	24,790	9,285	2,300
6/1/43 interconnection of - La Junta	2,834	1,420		
Las Animas	618	435		
Net additional load obligations		300		
1/1/44 conditions	39,827 kw.	26,945	9,285	3,597

PART TWO

10. The City of Lamar serves a number of towns in its vicinity in southeastern Colorado, among which is the town of Holly, the distribution system of which is owned by the Inland Utilities Company. The plant at Holly is interconnected with the system of Lamar but is not in operation. The total dependable capacity of Lamar is 5,900 kw. and of Holly is 125 kw., making a total of 6,025 kw.

11. Table III-G (Lamar) shows the commitments for 1942 and 1943, and the estimated load losses for those years, which are combined to give the net effect upon the loading of the Lamar system.

TABLE III-G (Lamar)

EXPECTED LOAD INCREASE

	Commitments for 1942 over 1941	Commitments for 1943 over 1942
Increase in large loads		
Air Base	500 kw.	
Martin Dam	50	
Detention Camp	700	
Total increase in large loads	1,250	
Normal increase in small loads	200	200 kw.
Total increase in area load	1,450	200
Load losses:		
Due to completion of Martin Dam	950	
Caused by daylight saving	50	
Total decrease in area load	1,000	
Diversified effect of above changes in area loads - Coincidental demand		
Total increase in large loads	1,125	
Normal increase in small loads	200	200
Total increase in area loads	1,325	200
Total decrease in area loads	1,000	
Net additional increase in area	325 kw.	200 kw.

12. Application of the expected net load increase at Lamar for 1942 to the January 1, 1942 condition gives the condition anticipated as of January 1, 1943 and is shown in Table III-H (Lamar).

TABLE III-H (Lamar)

	Dependable Capacity	Peaks	Reserve	Surplus
1/1/42 conditions	6,025 kw.	3,300	3,400	- 675
Net additional load obligations		325		
1/1/43 conditions	6,025	3,625	3,400	-1,000

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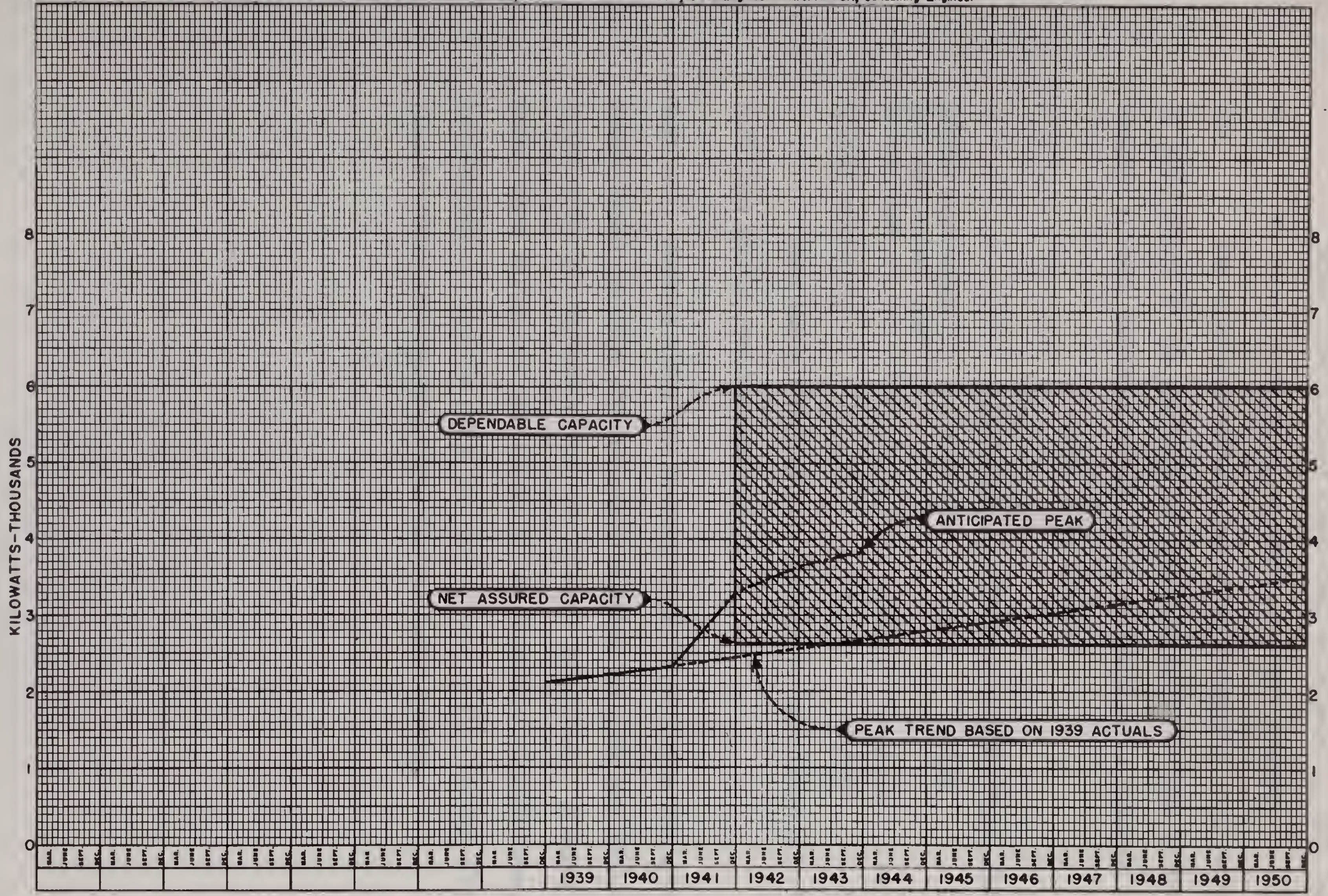

PEAKS AND CAPACITIES OF POWER SYSTEMS
AREA III — LAMAR
(ANNUAL PEAKS SHOWN AT END OF YEAR)
HERBERT S. SANDS, CONSULTING ENGINEER

DRAWING III-b LAMAR

[illegible]

Table III-H (Lamar) shows that on January 1, 1943 the system will be using approximately 1,000 kw. of its reserve.

13. The condition anticipated as of January 1, 1944 is obtained by application of the expected net load increase for 1943 to the January 1, 1943 condition and is shown in Table III-J (Lamar).

TABLE III-J (Lamar)

	Dependable Capacity	Peaks	Reserve	Surplus
1/1/43 conditions	6,025 kw.	3,625	3,400	- 1,000
Net additional load obligations		200		
1/1/44 conditions	6,025	3,825	3,400	- 1,200

This table shows that on January 1, 1944 Lamar will be using 1,200 kw. of its reserve capacity.

14. Drawing III-b and Drawing III-b (Lamar) show the actual annual peaks for 1941 and the expected peaks for 1942 and 1943 in their relation to the dependable and net assured capacities. Drawing III-b shows these values for the system of the Southern Colorado Power and interconnection with La Junta and Las Animas, while Drawing III-b (Lamar) shows corresponding data for the Lamar system.

15. Should further war loads materialize, relief could be had from interconnecting the Lamar system with the transmission line owned by the City of Las Animas, provided Las Animas is interconnected with the Southern Colorado Power Company, by building seventeen miles of 24,000 volt line. No transformers would be required. The expense of this line would be approximately $15,000. The amount of copper required would be 43,900 pounds. The interchange between Las Animas and Lamar would be limited by the capacity of this interconnection, which extends existing lines, to a value of 2,000 kw.

16. Isolated plants in which interconnection is not considered as practicable -

System	Dependable Capacity as of January 1, 1942 KW
Over 30 miles to interconnected system -	
Highlands Utilities Company	
Eads	192
Springfield	307
Haswell	20

CONCLUSIONS:

A. If additional war loads make it advisable, the interconnection of Las Animas and La Junta with the system of the Southern Colorado Power Company can be made to increase the surplus capacity in the area.

B. Should the war loads increase in the Lamar system the interconnection of Lamar with the Las Animas-Southern Colorado Power Company transmission line would relieve the situation so far as Lamar is concerned, and would make the supply of energy from the Lamar system more stable.

ANALYSIS OF THE POWER SYSTEMS
IN WALSENBURG AND TRINIDAD, COLORADO,
AND DAWSON, NEW MEXICO
DESIGNATED AS AREA IV

BEING A PART OF THE ANALYSIS
OF ELECTRIC POWER
REQUIRED AND AVAILABLE
IN COLORADO AND WYOMING

AREA IV

1. The principal generating systems in Area IV are those of the Trinidad Electric Transmission, Railway, and Gas Company, which has steam plants located at Walsenburg and Trinidad, and the New Mexico Power Comapny which has a plant located at Dawson, New Mexico, which systems are interconnected. Trinidad and Walsenburg are located in southern Colorado in the heart of a productive coal area. The area includes a portion of northeastern New Mexico, within which the coal mining camp of Dawson is located. The New Mexico Power Company supplies service from Dawson south to Wagon Mound.

2. A statement of dependable capacity, reserves, net assured capacity, peaks, and kilowatthour output for 1941 appears in the following table.

TABLE IV-A

LOAD AND SUPPLY DATA FOR INTERCONNECTED POWER SYSTEMS IN AREA IV

Capacities as of January 1, 1942

	Dependable Capacity	Re-serves	Net Assured Capacity	1941 Peak KW	1941 Loads KWH
Trinidad Electric Transmission, Ry., and Gas Company					
Walsenburg plant	4,670 kw.	2,170 kw.	2,500 kw.	1,523	8,699,835
Trinidad plant	4,655	655	4,000	2,378	4,985,004
New Mexico Power Co.					
Dawson plant	4,060	4,060	0	3,200	16,287,000
Total	13,385	4,060 kw.	9,325 kw.	7,101	29,971,839
Less 1941 peak			7,101		
Surplus Capacity			2,224 kw.		

3. On Drawing IV-a are shown the locations of load centers which have been arbitrarily selected. The values of energy that will be available in the vicinity of these load centers for loads over and above the 1941 peak values are as follows:

Trinidad	2,000 kw.
Walsenburg	2,000 kw.
Dawson	800 kw.

4. The value at the load center simply indicates capacity of transmission facilities to serve that load center and at all times is limited by the commitments to other load centers and by available generating capacity.

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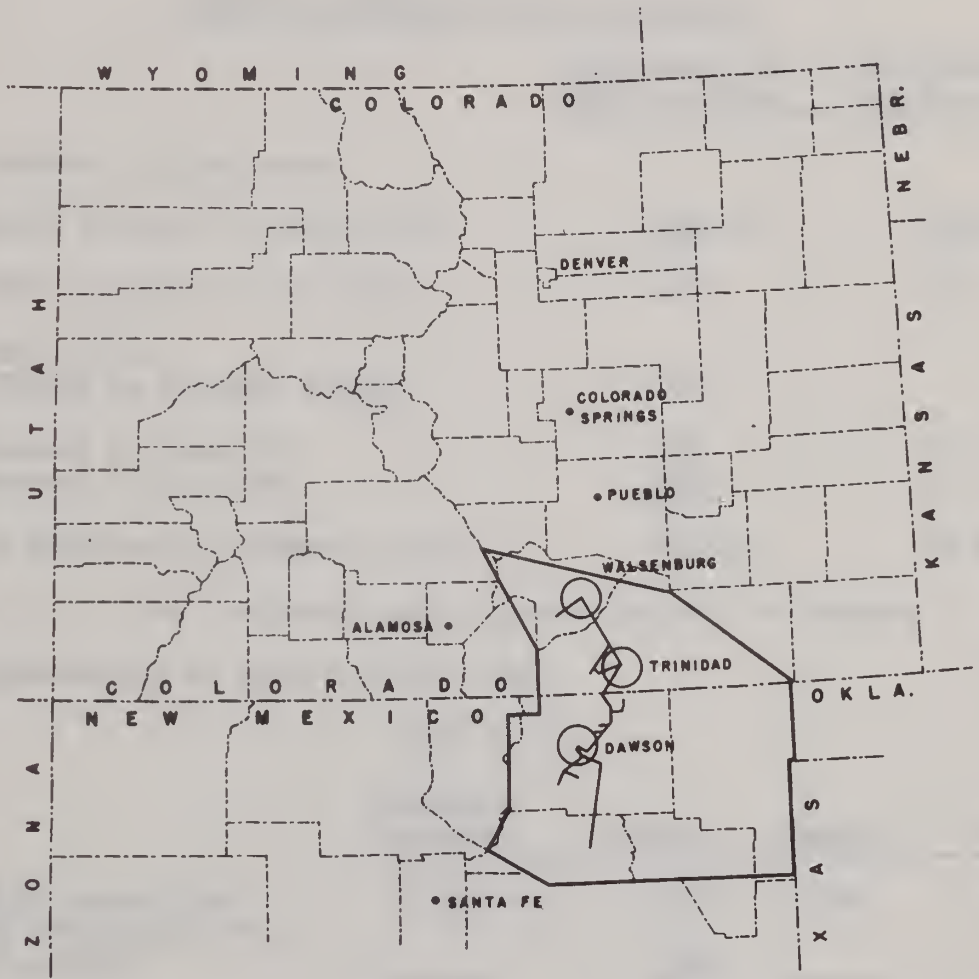
AREA IV

LOCATION OF LOAD CENTERS CONSIDERED



DRAWING IV-a

5. The principal industry in this area is coal mining and it is not considered that there will be any material increase in load from this particular source at the time of the annual peak. It is estimated that a probable increase in small loads will occur both in 1942 and 1943. This will be offset to some extent by the decrease in load due to daylight saving. These changes appear in Table IV-G as follows:

TABLE IV-G

EXPECTED INCREASE IN LOAD OF AREA IV

	Commitments for 1942 over 1941	Commitments for 1943 over 1942
Increase in large loads		
Normal increase in small loads	425 kw.	50 kw.
Total increase in area loads	425	50
Load losses:		
Caused by daylight saving	175	
Increase in area load	425	50
Decrease in area load	175	
Net additional increase in area	250 kw.	50 kw.

6. The conditions anticipated to exist as of January 1, 1943 are approximately as shown in Table IV-H.

TABLE IV-H

	Dependable Capacity	Peaks	Reserve	Surplus
1/1/42 conditions	13,385 kw.	7,101	4,060	2,224
Net additional load obligations		250		
1/1/43 conditions	13,385	7,351	4,060	1,974

7. The City of Raton in northern New Mexico is about the center of the area. It owns its own power plant and does business under the name of the Raton Public Service Company. As of January 1, 1942, this system was operating under the following conditions:

Dependable capacity	3,000 kw.
Reserve	1,500 kw.
Net assured capacity	1,500 kw.
Peak in 1941	1,420 kw.

Raton is not, at present, interconnected with any other system. This interconnection could be accomplished by the building of approximately one mile of line, at an expense, including line and transformers, of about $16,000 which would add to the surplus capacity 1,580 kw. The conditions of the load in the area are such that at the present time such connection is not necessary.

8. With the system of the Raton Public Service Company interconnected and the 1943 load obligations added, the approximate conditions for January 1, 1944 are obtained. These are shown in Table IV-J.

TABLE IV-J

	Dependable Capacity	Peaks	Reserve	Surplus
1/1/43 conditions	13,385	7,351	4,060	1,974
Interconnection of Raton	3,000	1,420		
Net additional load obligations		50		
1/1/44 conditions	16,385	8,821	4,060	3,504

9. Drawing IV-b shows the dependable capacity of the area and the net assured capacity, together with the actual and anticipated peaks to January 1, 1944 and the peak trend based on the estimates of the utilities made in 1939 covering a period of five years in the future.

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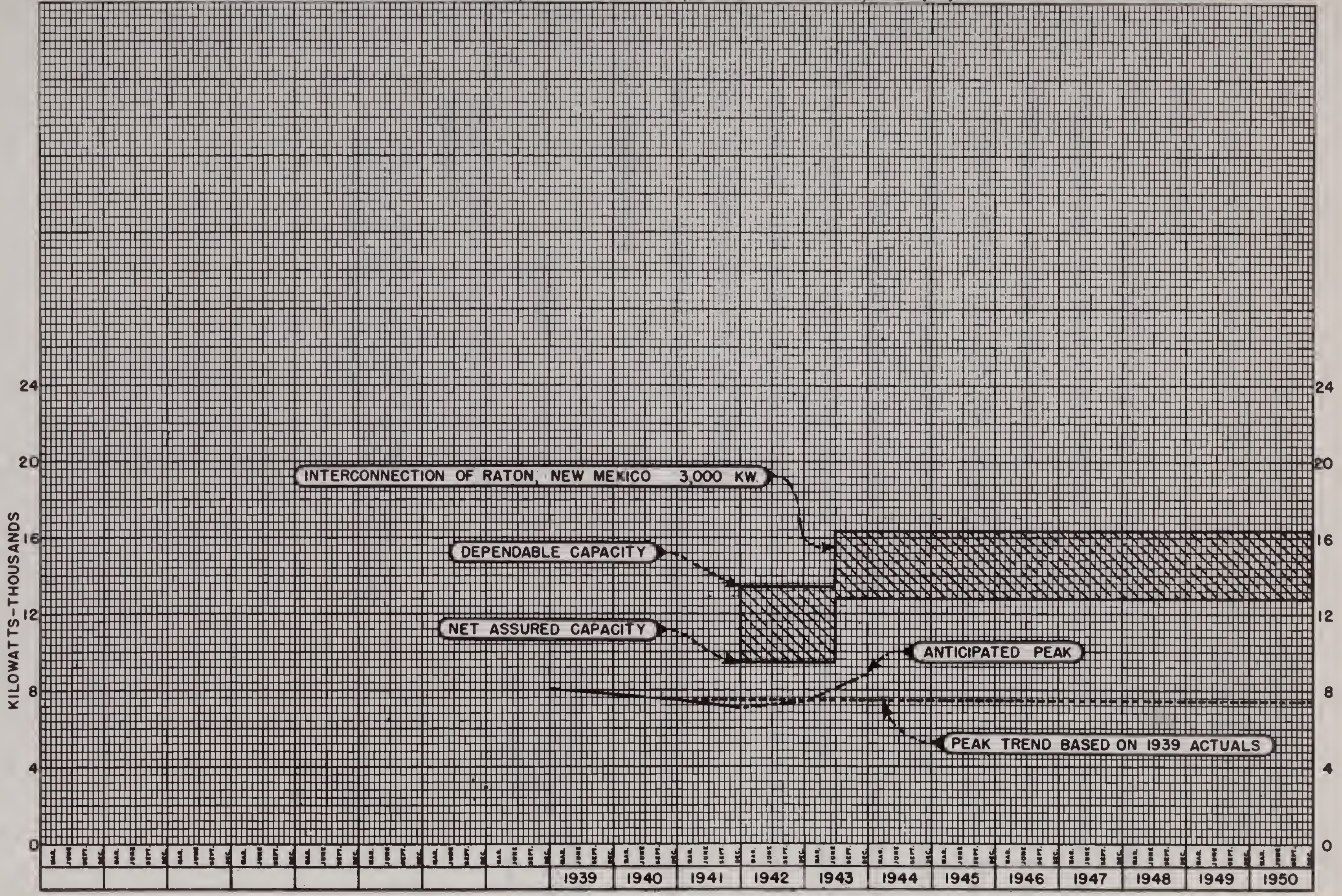

PEAKS AND CAPACITIES OF POWER SYSTEMS
AREA IV
(ANNUAL PEAKS SHOWN AT END OF YEAR)
HERBERT S. SANDS, CONSULTING ENGINEER

DRAWING IV-b

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10. This is a district having very advantageous coal conditions in that it is in the heart of an area producing large quantities of good quality coal.

11. Improvements in the boiler facilities of the Trinidad Electric Transmission, Railway & Gas Company's Walsen Plant, at Walsenburg, would materially increase the capacity. The installation of an additional unit at Dawson would increase the capacity available in the area. These additions would be economically sound from a production cost standpoint, because of the advantageous coal conditions noted above. Neither of these installations is a necessity insofar as the development of this area is concerned, but both will be considered as part of the discussion pertaining to interconnection of areas.

12. Isolated plants in which interconnection is not considered as practicable -

System	Dependable Capacity as of January 1, 1942 KW
Over 30 miles to interconnected system -	
Mora Public Service Company	15
Lincoln Utility Co., Roy, New Mexico	75
Clayton, New Mexico	500

CONCLUSIONS:

A. There is no present necessity, so far as Area IV is concerned, for increased capacity. When discussing the question of interconnection for areas, the advantageous conditions from a fuel and water standpoint will compel the consideration of improvements in the generating system at Walsenburg and of a capacity increase in the generating system at Dawson as a means of meeting the demands of other areas for more power by means more economical than can otherwise be found. This solution also gives consideration to the lesser use of critical materials.

B. Should conditions require, consideration should be given to the interconnection with the Raton Public Service Company.

ANALYSIS OF THE POWER SYSTEMS
IN SAN LUIS VALLEY, COLORADO
DESIGNATED AS AREA V

BEING A PART OF THE ANALYSIS
OF ELECTRIC POWER
REQUIRED AND AVAILABLE
IN COLORADO AND WYOMING

AREA V

1. Area V is principally in the San Luis Valley of the Rio Grande River basin which is in the central southern part of the state. This interconnected system is owned by the Public Service Company of Colorado.

2. Table V-A shows the condition that existed January 1, 1942, so far as dependable capacity, reserves, net assured capacity, peak, and kilowatthours are concerned.

TABLE V-A

LOAD AND SUPPLY DATA FOR INTERCONNECTED POWER SYSTEMS IN AREA V

Capacities as of January 1, 1942

	Dependable Capacity	Re-serves	Net Assured Capacity	1941 Peak KW	1941 Loads KWH
Public Service Co. of Colorado San Luis Valley System					
Alamosa (steam)	5,500 kw.	3,000 kw.	2,500 kw.	3,400	10,222,050
Salida "	1,200	500	700	0	17,773
Salida (hydro)	1,020	1,020	0	1,460	8,651,376
Total	7,720 kw.	3,000 kw.	4,720 kw.	4,860	18,891,199
Less 1941 peak			4,860		
Surplus Capacity			- 140 kw.		

This table shows that a part of reserve capacity was being used during peak times.

4. The increases and decreases that are expected to occur during 1942 and 1943 are shown in Table V-G. The loss of the load at the town of Center is indicated. The town of Center installed its own generating plant of 255 kw. capacity and was disconnected from the major system early in 1942.

TABLE V-G

EXPECTED INCREASE IN LOAD OF AREA V

	Commitments for 1942 over 1941	Commitments f 1943 over 19
Increase in large loads		
Normal increase in small loads	50 kw.	50 kw.
Total increase in area load	50	50
Load losses:		
Caused by daylight saving	50	
Loss of Center, Colorado	135	
Total decrease in area load	185	
Total increase in area load	50	50
Total decrease in area load	185	—
Net additional increase in area	- 135 kw.	50 kw.

5. Table V-H shows the condition anticipated to exist January 1, 1943 so far as surplus is concerned.

TABLE V-H

	Dependable Capacity	Peaks	Reserve	Surplus
1/1/42 conditions	7,720 kw.	4,860	3,000	- 140
Net additional load obligations		- 135		
1/1/43 conditions	7,720	4,725	3,000	- 5

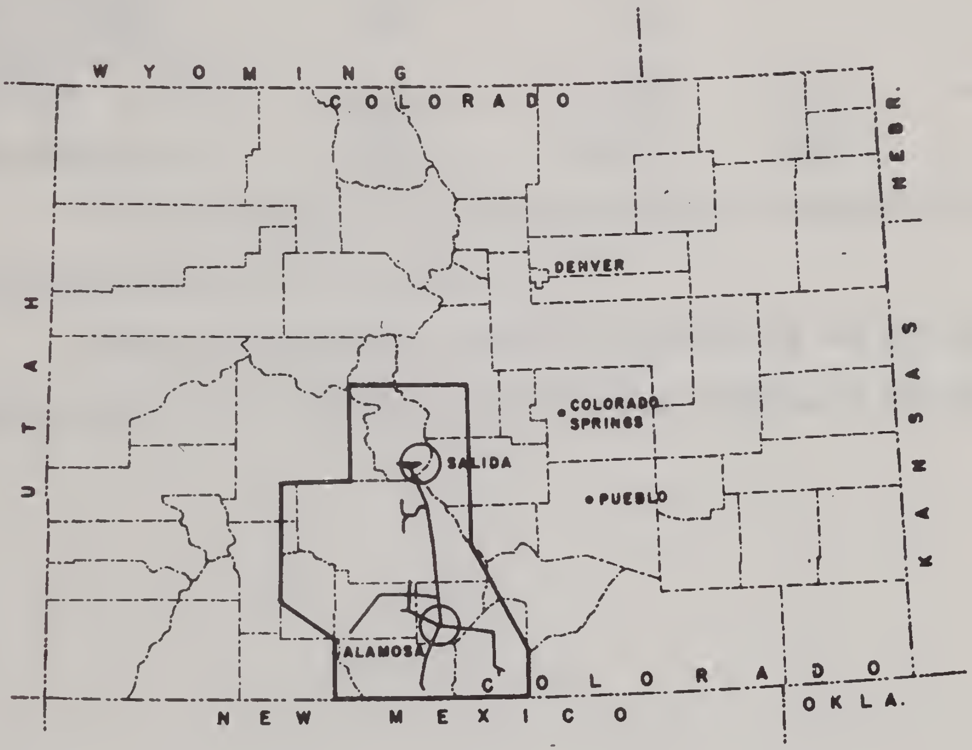
This table shows that with an allowance of 3000 kw. for reserve, no surplus capacity will exist.

3. Drawing V-a shows the location of the two principal load centers of Alamosa and Salida. If the reserves are disregarded, there would be available at Salida 1,200 kw., or at Alamosa 2,800 kw.

The value at the load center simply indicates the capacity of the transmission facilities to serve that load center, and at all times is limited by the commitments to other load centers and by available generating capacity.

AREA V

LOCATION OF LOAD CENTERS CONSIDERED



DRAWING V-e

6. Assuming that the town of Center is interconnected, and applying the net load obligations from Table V-G, the condition that would exist January 1, 1944 is shown in Table V-J.

TABLE V-J

	Dependable Capacity	Peaks	Reserve	Surplus
1/1/43 conditions	7,720 kw.	4,725	3,000	- 5
Interconnection - Town of Center	255	135		
Net additional load obligations		50		
1/1/44 conditions	7,975	4,910	3,000	65

This table shows, under these conditions, a surplus of 65 kw. over and above the 3,000 kw. reserve.

7. Drawing V-b shows the dependable capacity and the net assured capacity, together with the actual and anticipated peaks, in the area.

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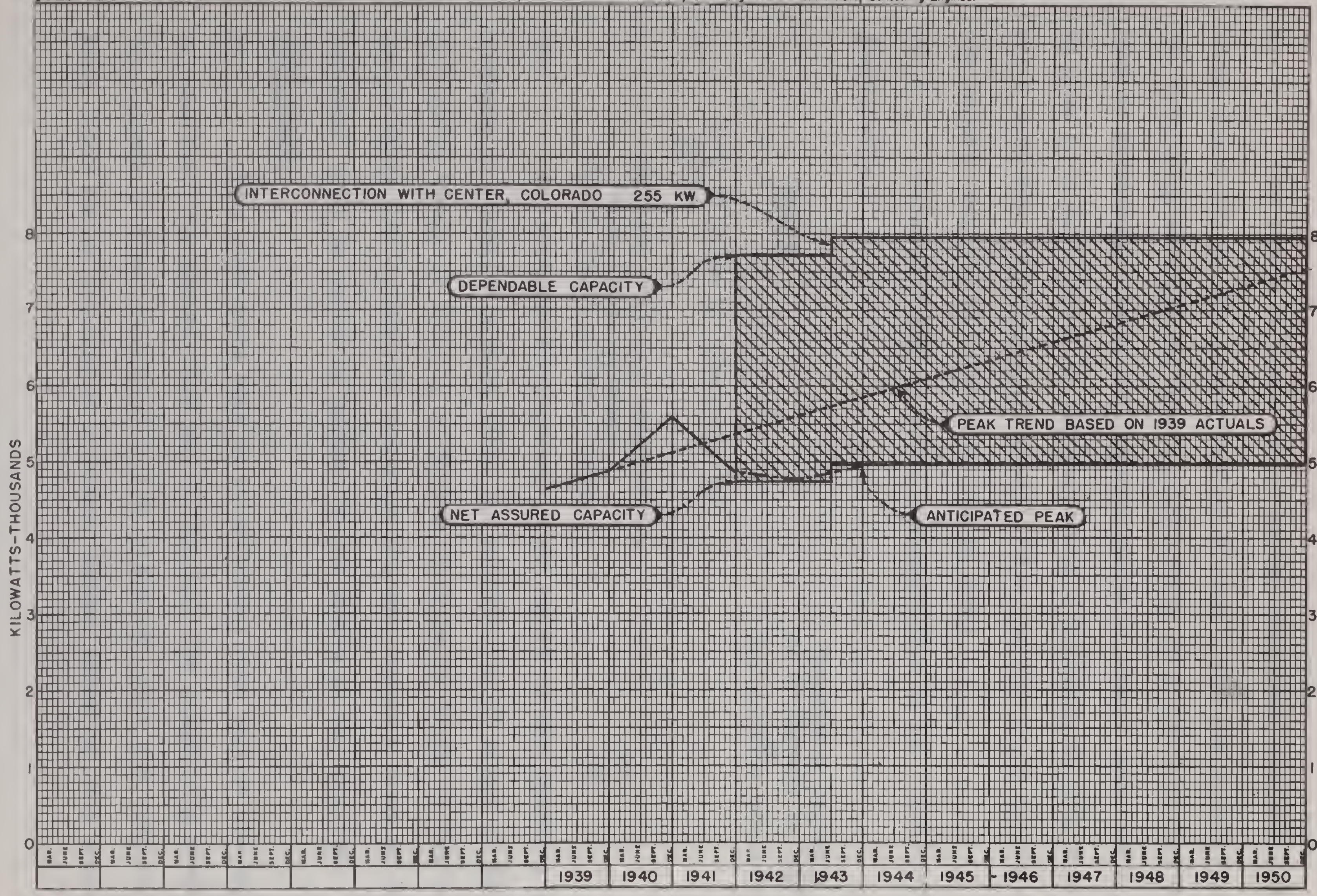

PEAKS AND CAPACITIES OF POWER SYSTEMS

AREA V

(ANNUAL PEAKS SHOWN AT END OF YEAR)

HERBERT S SANDS, CONSULTING ENGINEER

DRAWING V - b

8. The supply of power can be further augmented, provided conditions demand it, by the interconnection of Area V with the system in Area IV; such being accomplished by the construction of a line from Fort Garland to Walsenburg; or by the interconnection of Area V with the system in Area I, to be effected by construction of a transmission line from Leadville to Salida. Both of these possibilities are more fully covered by the section relating to interconnection of area.

9. Isolated plants in which interconnection is not considered as practicable -

System	Dependable Capacity as of January 1, 1942 KW
Over 30 miles to interconnected system -	
Mountain Utilities Corporation, Buena Vista, Colorado	275
Creede Light & Power Company	105

10. Mr. Gustavus Sessinghaus, in his report on the potential daily tonnages of essential metals, cites the possible use of energy at Salida in Chaffee County of 157 kw., at Bonanza in Saguache County of 209 kw., and at White Pine in Gunnison County of 224 kw.; making a total of 590 kw. All these could be served by making further drafts on the reserves.

CONCLUSION:

A. This area could take on an additional load only at the expense of reserves. The amounts that can be obtained from neighboring areas and the expense of interconnections will be discussed under that subject; however, there are no discernible or normal demands affecting this area.

AREA VI

1. This area is in the southwestern portion of Colorado and the principal industry of this area is now, and has been for many years, metal mining. The major power system is the fully interconnected system of the Western Colorado Power Company and is one of the earliest systems developed in the world. It has eight power plants, four of which are hydro plants. The steam plants at Durango and Montrose have been held in reserve to a large extent, only being used when necessary.

2. Table VI-A shows the dependable capacity, reserves, and the net assured capacity as of January 1, 1942. It also discloses the peak and kilowatthours generated for 1941.

TABLE VI-A

LOAD AND SUPPLY DATA FOR INTERCONNECTED POWER SYSTEMS IN AREA VI

Capacities as of January 1, 1942.

	Dependable Capacity	Re-serves	Net Assured Capacity	1941 Peak KW	1941 Loads KWH
Western Colorado Power Company					
Oliver (steam)	1,200 kw.	1,200 kw.	0 kw.		5,004,190
Paonia "	196	100	96		10,000
Montrose "	300	150	150		0
Durango "	700	700	0		4,580
Tacoma (hydro)	4,830	2,430	2,400		14,131,840
Ames "	2,350	2,350	0		15,160,460
Ilium "	1,260	1,260	0		3,783,320
Ouray	700	700	0		3,652,505
Total	11,536 kw.	2,430 kw.	9,106 kw.	8,540	41,746,895
Less 1941 peak			8,540		
Surplus Capacity			566 kw.		

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ANALYSIS OF THE POWER SYSTEMS
IN SOUTHWESTERN COLORADO
DESIGNATED AS AREA VI

BEING A PART OF THE ANALYSIS
OF ELECTRIC POWER
REQUIRED AND AVAILABLE
IN COLORADO AND WYOMING

3. In addition to the system of the Western Colorado Power Company shown in Table VI-A there is a plant at the City of Delta, owned by the city, having a dependable capacity of 1,060 kw., a reserve capacity of 510 kw., and a net assured capacity of 550 kw. Their peak in 1941 was 570 kw. and the kilowatthours generated were 2,467,000. This plant is not interconnected with the general system.

4. Drawing VI-a shows the various load centers which were arbitrarily chosen and in the immediate vicinity of these load centers the following amounts of power can be made available for additional loads over and above the 1941 peak:

Durango	550 kw.
Telluride	550 kw.
Silverton	550 kw.
Ouray	550 kw.

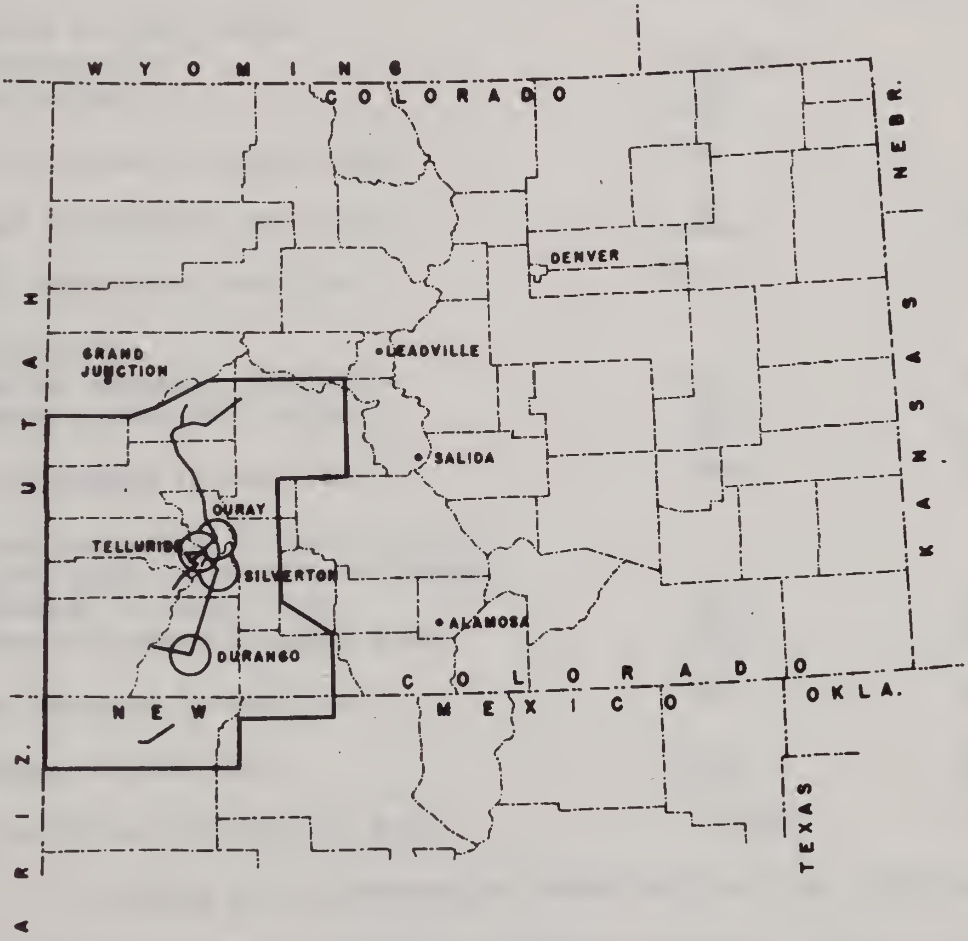
5. If the plant at Delta were interconnected these values would be changed to the following:

Durango	1,000 kw.
Telluride	1,000 kw.
Silverton	1,000 kw.
Ouray	1,000 kw.

6. The value at the load center simply indicates the capacity of the transmission facilities to serve that load center, and at all times is limited by the commitments to other load centers and by available generating capacity.

AREA VI

LOCATION OF LOAD CENTERS CONSIDERED



DRAWING VI-a

7. The commitments made by the Western Colorado Power Company which are likely to materialize, and the losses in load that will probably occur, in the years 1942 and 1943, are shown in Table VI-G.

TABLE VI-G

EXPECTED INCREASE IN LOAD OF AREA VI

	Commitments for 1942 over 1941	Commitments for 1943 over 1942
Increase in large loads		
Vanadium mill	300 kw.	
Box factory	40	
Total increase in large loads	340	
Normal increase in small loads	50	50 kw.
Total increase in area load	390	50
Load losses:		
Due to decreased population	225	25
Caused by daylight saving	75	
Total decrease in area load	300	25
Diversified effect of above changes in area loads - Coimcidental demand		
Increase in large loads	300	
Normal increase in small loads	50	50
Total increase in area load	350	50
Decrease in area load	300	25
Net additional increase in area	50 kw.	25 kw.

8. Taking into consideration these load and loss expectancies, the surplus that will probably be available January 1, 1943 is shown in Table VI-H.

TABLE VI-H

	Dependable Capacity	Peaks	Reserve	Surplus
1/1/42 conditions	11,536 kw.	8,540	2,430	566
Net additional load obligations		50		
1/1/43 conditions	11,536	8,590	2,430	516

9. The Western Colorado Power Company has an additional 700 kw. turbine which is not in use but which can be prepared for use rather rapidly. This is at the Durango plant. Therefore, in Table VI-J it is contemplated that during 1943 the interconnection with Delta will be effected and the additional unit will be put into service. The table shows the surplus that may be expected January 1, 1944 under these conditions, after considering load obligations for 1943.

TABLE VI-J

	Dependable Capacity	Peaks	Reserve	Surplus
1/1/43 conditions	11,536 kw.	8,590	2,430	516
6/1/43 interconnection of Delta	1,060	570		
Additional unit at Durango	700			
Net additional load obligations		25		
1/1/44 conditions	13,296	9,185	2,430	1,681

10. Drawing VI-b shows the dependable capacity and the net assured capacity, together with the actual and anticipated peaks, for the area.

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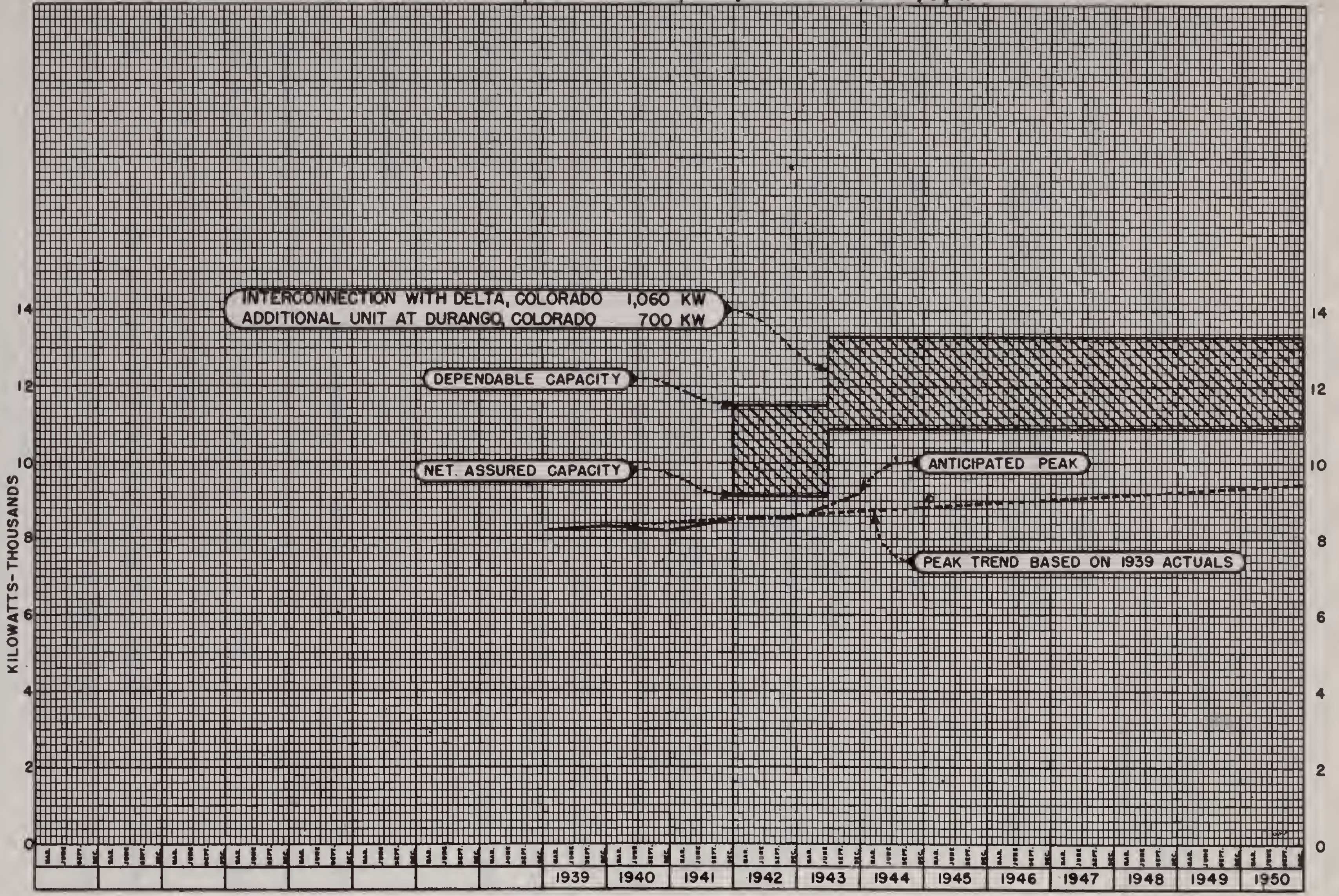
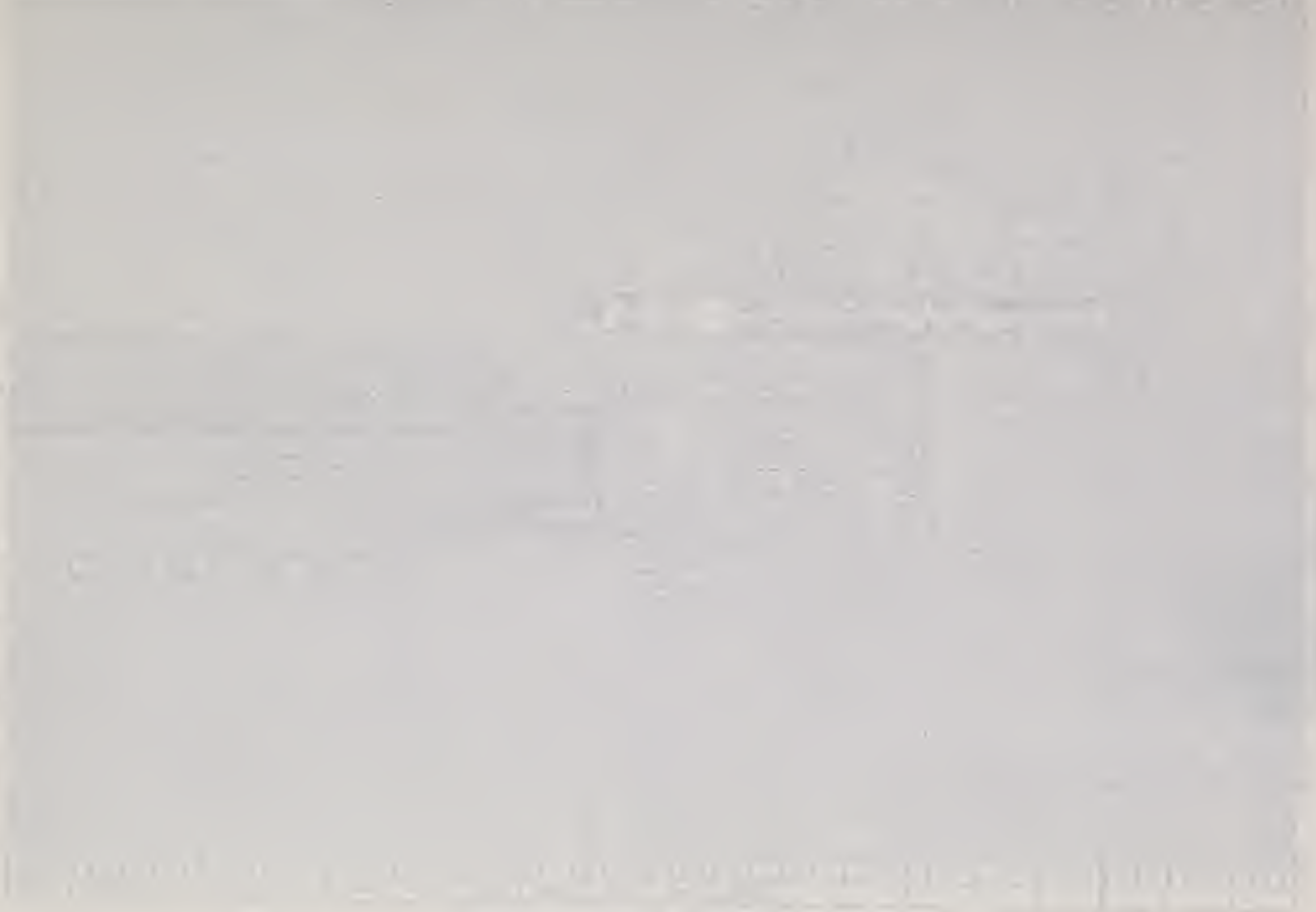


PEAKS AND CAPACITIES OF POWER SYSTEMS
AREA VI
(ANNUAL PEAKS SHOWN AT END OF YEAR)
HERBERT S. SANDS, CONSULTING ENGINEER

DRAWING VI-b



11. Isolated plants in which interconnection is not considered as practicable -

System	Dependable Capacity as of January 1, 1942 KW
Under 30 miles to interconnected system -	
San Miguel Light & Power Co., Norwood	112
Pine River Power Company, Bayfield	225
Over 30 miles to interconnected system -	
Empire Electric Ass'n., Dove Creek	100
Crested Butte	350
Gunnison	940
New Light & Power Co., Pagosa Springs	275
New Mexico Public Service Company San Juan Division (Farmington-Aztec, N.M.)	750

12. The report of Mr. Gustavus Sessinghaus, Mining Engineer of Denver, on the additional tonnage of critical materials that can be obtained from this area shows that it might require, if all the various locations are developed, some 3,450 kw. of coincidental daily demand. If this demand should be made on the system it would be necessary to install additional steam capacity at Durango or interconnect with other areas.

CONCLUSIONS:

A. In Area VI by January 1, 1943 there will be a surplus of approximately 500 kw. With the interconnection of Delta and the putting into service of the additional unit at Durango there will be as of January 1, 1944 a surplus of 1,680 kw.

B. If the mining load mentioned by Mr. Sessinghaus should all materialize, it will be necessary to put in additional steam equipment at Durango or interconnect with adjacent areas; this will be covered in the discussion of area interconnection.

INTERRELATION OF AREAS

BEING A PART OF THE ANALYSIS
OF ELECTRIC POWER
REQUIRED AND AVAILABLE
IN COLORADO AND WYOMING

INTERRELATION OF AREAS

The Areas, I through VI inclusive, covered by this report in the states of Wyoming and Colorado were carrying a war load on January 1, 1942 of 13,418 kw. In 1939 the Federal Power Commission requested the Class I and Class II utilities to estimate what their peak loads would be for five years in the future. The sum of all the peaks expected for 1941 of the Class I and Class II utilities, which constitute over 90% of the utilities in the two states from a standpoint of dependable capacity, plus the equivalent amount expected from the Class III utilities, based on their 1939 peaks, amounted to 205,070 kw. for the areas as covered by this report. For example, the actual peak of all such utilities in December, 1941 was 218,488 kw., leaving a difference of 13,418 kw. which is presumed to be war load.

Practically all the utilities have made war commitments, some of which will mature during 1942 and the balance in 1943. Taking these commitments into consideration, the war loads that will be carried by such utilities will be as follows: January 1, 1942 being actual; the other years being determined on the basis of the reports above referred to:

1/1/42	13,418 kw.
1/1/43	33,449 kw.
1/1/44	60,323 kw.

There is an increase over their expected loads as follows:

1941	6.5 %
1942	15.8 %
1943	27.2 %

The actual conditions of these utilities in the two states by areas on January 1, 1942 are shown in the following table:

CONDITIONS AS OF JANUARY 1, 1942

	Dependable Capacity KW	Peaks KW	Reserves KW	Net Assured Capacity KW	Surplus over Reserve KW
Area I	235,679	163,262	29,000	206,679	43,417
Area II	16,386	9,700	5,000	11,386	1,686
Area III	42,920	25,025	12,685	30,235	5,210
Area IV	13,885	7,101	4,560	9,325	2,224
Area V	7,720	4,860	3,000	4,720	- 140
Area VI	11,536	8,540	2,430	9,106	566
Total+	327,626	218,488	56,175	271,451	52,963

+ (Exclusive of isolated plants not feasible of interconnection)

In all the areas the peak occurred in December, 1941, with the exception of Area III (Arkansas Valley). Area III had its peak in September due to the fact that it was called on to furnish emergency power to the Colorado Fuel & Iron during that month. In previous years this peak has always occurred in December.

On January 1, 1942 the dependable capacity of all utilities in the two states plus the capacity of the New Mexico Power Company was 389,585 kw. and the dependable capacity of the presently interconnected systems was 327,626 kw. These are located as follows:

	Total Dependable Capacity	Dependable Capacity of Interconnected Systems
Wyoming	92,703 kw.	61,342 kw.
*Colorado	296,882 kw.	266,284 kw.

Note:- *Includes Dawson Plant of New Mexico Power Company.

The dependable capacity of interconnected systems, totaling 434,336 kw., is generated as follows:

Steam	248,816 kw.
Hydro	73,320 kw.
Internal Combustion	5,490 kw.

The conditions expected as of January 1, 1943, including the commitments and changes in capacity that are expected to take place in 1942, are shown in the following table:

CONDITIONS AS OF JANUARY 1, 1943

	Dependable Capacity KW	Peaks KW	Reserves KW	Net Assured Capacity KW	Surplus over Reserve KW
Area I	233,581	180,550	29,000	204,581	24,031
Area II	20,886	15,750	5,000	15,886	136
Area III	42,400	28,415	12,685	29,715	1,300
Area IV	13,885	7,351	4,560	9,325	1,974
Area V	7,720	4,725	3,000	4,720	- 5
Area VI	11,536	8,590	2,430	9,106	516
Total+	329,508	245,381	56,175	273,333	27,952

+ (Exclusive of isolated plants not feasible of interconnection)

The commitments that are expected to mature, together with the contemplated change in dependable capacity during 1943 are shown in the following table, as presenting the conditions that it is contemplated will exist as of January 1, 1944.

CONDITIONS AS OF JANUARY 1, 1944

	Dependable Capacity KW	Peaks KW	Reserves KW	Net Assured Capacity	Surplus over Reserve KW
Area I	265,181	211,850	32,250	232,931	21,081
Area II	20,886	16,450	5,000	15,886	- 564
Area III	45,852	30,770	12,685	33,167	2,397
Area IV	16,885	8,821	4,560	12,325	3,504
Area V	7,975	4,910	3,000	4,975	65
Area VI	13,296	9,185	2,430	10,886	1,681
Total+	369,575	281,986	59,425	310,150	28,164

+ (Exclusive of isolated plants not feasible of interconnection)

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The surplus in the above tabulations is purely that existing at generating plants and does not comprehend in any way transmission losses.

In the above tables there will be noted a material increase in the dependable capacity between January 1, 1942 and January 1, 1944, and a decrease in surplus over reserve capacity during the same period of time. The increase in dependable capacity can be attributed to the coming in of the Green Mountain plant of the Colorado-Big Thompson; to the rewinding of turbine No. 1 in the Valmont station of the Public Service Company; to the interconnection by the City of Colorado Springs with the Golden Cycle Mining Company; and to the increased boiler capacity of Colorado Springs municipal plant. In addition, increase in dependable capacity is due to the suggested interconnection of the following operating plants with the main systems in their areas.

City of Fort Collins	Area I
City of Longmont	Area I
Town of Lyons	Area I
City of La Junta	Area III
City of Las Animas	Area III
City of Raton	Area IV
Town of Center	Area V
City of Delta	Area VI

Also it is suggested in the Area III Study that the City of Las Animas transmission system be extended to connect with the transmission system of the City of Lamar, to make possible the interchange of 2,200 kw.

The decrease in surplus over reserve kilowatts from 1942 to 1944 is due to the contemplated war loads.

Many of the areas can operate without reserve by taking care of required maintenance during the months of low demand.

If the exigencies of the situation justify it, a pooling of

reserves can be made by interconnection of areas to increase available surplus capacity. Inasmuch as the location and required demand of additional war loads is not known it is impossible at the present time to make specific studies. Possible area interconnections and additional generating installations are herein set forth.

The summarization by areas includes not only interconnections within the areas that have already been mentioned, but also interconnections between areas (which are described more fully in the appendix) as well as installations that could be made if conditions require.

AREA I

The conditions of Area I, as of January 1, 1944, show that after taking care of all expected war commitments and allowing for reserves of 32,250 kw., there will be a surplus capacity at that time of 21,081 kw. at the generating stations. In considering this reserve, it must be remembered that this area has over 2,000 miles of transmission lines that interconnect approximately 20 generating systems.

This surplus is dependent upon the following:

1. The addition of systems by interconnection -
    - The City of Fort Collins
    - The City of Longmont
    - The Town of Lyons
    - The Sterling-Brush System of the Public Service Company of Colorado
2. The addition of new capacity
    - The reblading of the No. 1 turbo-unit in the Valmont plant of the Public Service Company of Colorado

    - The Green Mountain plant of the Colorado-Big Thompson Project of the U. S. Bureau of Reclamation

If all these are accomplished, Area I will have ample capacity to take care of its obligations. The above interconnections and capacity additions are thoroughly practicable.

Should additional demands for power be made in this area for war purposes over and above the surplus as of January 1, 1944, consideration has been given to the possible methods of supplying these demands.

The methods considered for obtaining additional capacity are as follows:

The installation of a new 56,250 kw. unit at the Valmont plant of the Public Service Company (Appendix 6); the interconnection of Areas I, II, III, and IV by the installation of a line from Denver to Walsenburg (Appendix I); the interconnection of Areas I, IV, and V by the installation of a line from Walsenburg to Leadville by way of Alamosa and Salida (Appendix 4).

AREA II

In Area II there are 185 miles of transmission lines. It has been shown that by January 1, 1944, the power demands for the Area will require the use of part of the reserves. The conditions contemplated as of January 1, 1944 include the purchase by the City of Colorado Springs of 2,500 kw. from the Golden Cycle Mining Company; and the installation of new boiler equipment at the Colorado Springs plant to increase the dependable capacity by 2,000 kw. Should new war loads demand it, additional capacity for the area could be obtained by the purchase of an additional 2,500 kw. from the Golden Cycle Mining Company (Appendix 7), or the installation of a 5,000 kw. unit by the City of Colorado Springs (Appendix 8). Pooling the reserves by interconnecting Areas II and III would release 5,000 kw. for Area II. This interconnection would require the building of a transmission line from Colorado Springs to Pueblo

(Appendix 2). The further pooling of reserves by interconnecting Areas II, III, and IV with a transmission line from Colorado Springs through Pueblo to Walsenburg would release 10,000 kw. for the area (Appendices 2 and 3). The interconnection of Areas I, II, III, and IV by building a transmission line from Denver to Walsenburg will allow power to be transmitted to Area II from the other areas (Appendix 1).

AREA III

The surplus that has been shown to exist in Area III, as of January 1, 1944, is dependent upon the interconnection of the cities of Las Animas and La Junta with the major system. This area has approximately 350 miles of transmission line. If additional war loads should demand power over and above the surplus as of January 1, 1944, other sources of capacity would have to be found. Additional capacity can be brought into the area by building a line from Denver to Walsenburg interconnecting Areas I, II, III, and IV (Appendix 1). This interconnection would make possible the pooling of reserves and would allow the moving of approximately 10,000 kw. surplus to Pueblo.

By January 1, 1944, the Lamar system will be drawing heavily upon its reserves. Relief could be given to this situation by extending the present Lamar-Caddoa transmission line to connect with the Las Animas system. The amount of additional capacity that could be moved to Lamar by this interconnection is limited to 2,000 kw. by the capacity of the present Lamar-Caddoa line. This interconnection is justified by the two contemplated war loads at Lamar.

AREA IV

There are 250 miles of transmission lines in Area IV. The surplus shown to exist, as of January 1, 1944, depends upon the interconnection with the City of Raton system. This surplus is sufficient to take care of contemplated loads, Should war loads demand it, additional power may be brought into the area by the interconnection of Areas I, II, III, and IV as has been previously mentioned (Appendix 1). Interconnecting Areas I, IV, and V by building a line from Walsenburg to Fort Garland, reinsulating the present lines from Fort Garland to Salida, and building a line from Salida to Leadville, would make 6,000 kw. available at Walsenburg (Appendix 4).

Additional generating capacity of 4,330 kw. can be obtained for the area by installing new high pressure boilers at the Walsen plant of the Trinidad Electric Transmission, Railway, & Gas Company to enable the present largest turbine to operate at its full capacity (Appendix 9). This power could be sent to Areas I, II, III, or V, if the interconnections given above were made, and Leadville could be furnished 5,000 kw. (Appendix 4). If demands for this power were at Trinidad or further south, it would be necessary to build a new 44 kv. transmission line from Walsenburg to Trinidad (Appendix 9).

An additional 6,250 kva. unit with a dependable capacity of 5,000 kw. can be installed at the Dawson plant of the New Mexico Power Company (Appendix 10).

The power from Dawson could be transmitted to Walsenburg, should the new Walsenburg-Trinidad 44 kv. line be constructed (Appendix 9).

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AREA V

The surplus shown to exist in Area V, as of January 1, 1944, takes into consideration the interconnection of the plant at Center with the major system. The 285 miles of transmission lines in this area are combined into one system. Area V has practically no surplus over the reserve capacity. There are no war loads contemplated. If conditions justify it, construction of a line connecting Areas IV, V, and I would enable pooling the reserve of Area V with that of either Area I or IV to increase the surplus capacity available in the area. (Appendix 4)

AREA VI

Area VI has approximately 320 miles of transmission lines. The surplus shown as of January 1, 1944 is dependent upon the interconnection of Delta with the major system and the placing into service of an additional 700 kw. unit at the Durango plant. The area has ample surplus over and above the reserves to take care of the present commitments. In the report of Mr. Gustavus Sessinghaus, he has shown the possible requirements for 3,450 kw. to be used in the mining of strategic metals in this area. Should this load develop, it would be necessary for the area to operate with practically no reserve. Additional power could be brought into the area by interconnecting Area I with Area VI. This interconnection would require the building of a 44 kv. line from Palisade to Delta, and reinsulating the present 11 kv. line from Delta to Montrose. It would be capable of delivering 2,500 kw. to Montrose. (Appendix 5)

The generating capacity in the area could be increased by installing a new 1,000 kw. unit complete with boiler equipment at Durango. (Appendix 11)

APPENDIX

(COST OF INTERCONNECTIONS AND ADDITIONAL GENERATION FACILITIES)

BEING A PART OF THE ANALYSIS
OF ELECTRIC POWER
REQUIRED AND AVAILABLE
IN COLORADO AND WYOMING

-1-

INTERCONNECTION OF DENVER-COLORADO SPRINGS-PUEBLO-WALSENBURG

Areas I, II, III, and IV could be interconnected, should the exigencies of the situation justify it, by building a 115 kv. line from Denver to Walsenburg. This could be built of No. 1 copper to have a capacity from Denver to Walsenburg of 9,000 kva., from Denver to Pueblo of 12,500 kva., and from Denver to Colorado Springs of 20,000 kvs. It would take 750,000 pounds of copper, and could be built at an expense of $700,000. This price does not include the sub-stations which would be required.

There would be power available to deliver approximately 17,000 kw. to Denver or vicinity. If the flow were in the opposite direction, there could be delivered 17,000 kw. from Denver to Colorado Springs, 10,000 kw. from Denver to Pueblo, or 8,000 from Denver to Walsenburg.

The necessary sub-stations could be built for approximately $400,000, making a total cost for the interconnection of $1,100,000. Assuming an interchange of 17,000 kw. the cost would be approximately $65 per kw.

-1a-

INTERCONNECTION OF DENVER-COLORADO SPRINGS

The interconnection of Areas I and II could be accomplished by building a line approximately 75 miles in length between Denver and Colorado Springs. This line should be constructed for 115 kv. and would have a capacity of 17,000 kw. The cost of the line, without sub-stations, would be $310,000 and would require 350,000 pounds of copper. The necessary sub-stations would cost $160,000 making a total cost of $470,000. If this line were utilized to its full capacity it would

mean a cost of something less than $30 per kw. However, there is no present nor discernible demand that would justify this line at the present time.

-2-

INTERCONNECTION OF COLORADO SPRINGS-PUEBLO

The interconnection of Areas II and III could be accomplished by building a line 45 miles in length between Colorado Springs and Pueblo. This line should be constructed for 115 kv. but operated at 66 kv. It would have a capacity of 10,000 kw. The cost of the line without sub-stations would be about $180,000 and would take 184,000 pounds of No. 1 copper. It would enable a pooling of reserves between Areas II and III.

The sub-stations of 5,000 kva. capacity each at Colorado Springs and Pueblo would cost approximately $90,000, making a total cost of $270,000 to enable utilization of 5,000 kw. now held in reserve. The cost would be approximately $55 per kw. The present and discernible demands do not justify this line.

-3-

INTERCONNECTION OF PUEBLO-WALSENBURG

The interconnection of Areas III and IV would make possible pooling the reserves of these two areas. This could be accomplished by building 52 miles of line between Pueblo and Walsenburg. This line should be constructed for 115 kv. but operated at 66 kv.

The line would cost approximately $210,000 and would utilize 213,000 pounds of No. 1 copper. This would set free approximately 5,000

kw. for utilization at either Pueblo, Walsenburg, or some intermediate point. On the basis of a 5,000 kw. sub-station at Walsenburg and one of similar size at Pueblo the sub-stations would cost approximately $90,000, making a total cost of approximately $300,000. This cost would be $60 per kw. of capacity released. The present and discernible demands do not justify this line.

-4-

INTERCONNECTION OF WALSENBURG-ALAMOSA-SALIDA-LEADVILLE

The interconnection of Areas IV, V, and I would mean running a 69 kv. line from Leadville to Salida; reinsulating the line from Salida to Fort Garland, which is now 44 kv. and 22 kv., so that it could operate at 69 kv.; and running a 69 kv. line from Fort Garland to Walsenburg. This would be a total distance of 220 miles. This line would cost $278,000. The necessary sub-stations located at Leadville, Walsenburg, Alamosa, Salida, Sargent, Kerber Creek, and Fort Garland would cost $272,000, making the total cost of the project $550,000, or $110 per kw. delivered at Leadville. The line would require 372,000 pounds of No. 2 copper to enable the delivery at Leadville of 5,000 kw. A somewhat greater amount of power could be delivered at intermediate points, if required for war loads. The present and discernible demands do not justify this line.

-5-

INTERCONNECTION OF PALISADE-DELTA-MONTROSE

An interconnection of Area I and Area VI could be accomplished by building 50 miles of 44 kv. transmission line from Palisade to Delta and reinsulating the present 11 kv. line from Delta to Montrose. This line would cost approximately $125,000 and would require 160,000 pounds of No. 2. copper. It would be capable of delivering 2,500 kw. to Area VI at Delta or Montrose. This cost includes the necessary transformers. The necessary switching and protective equipment would cost approximately $10,000 making a total cost of the line $135,000, or $54 per kw.

-6-

A 50,000 KW. UNIT AT VALMONT PLANT

A 50,000 kw. unit could logically be installed at the Valmont Plant. This would furnish a dependable capacity of 56,250 kw. and cost approximately $4,000,000. It would have a production cost of 2.35 mills per kwh. at 100% load factor, or 2.96 mills per kwh. at 60% load factor.

-7-

INCREASED CAPACITY, CITY OF COLORADO SPRINGS

Arrangements could be made with the Golden Cycle Mining Company for installation of new boiler equipment. Such installation would enable this company to supply an additional 2,500 kw. for the benefit of the Electric Department of the City of Colorado Springs.

-8-

A 5,000 KW. UNIT AT COLORADO SPRINGS

A unit of 5,000 kw. dependable capacity could be installed at Colorado Springs at a cost for necessary boiler and generating equipment of $500,000.

-9-

REMODELING BOILER EQUIPMENT AT WALSEN PLANT

By Remodeling the boiler equipment and installing a 100,000 lb. per hour integral furnace and boiler, complete with stacks and preheaters, at the Walsen Plant of the Trinidad Electric Transmission, Railway & Gas Company, the steam pressure could be increased to 400 pounds with 700 degrees super heat. This would enable the operation of the present turbine at its full rating of 7,500 kw. to raise its dependable capacity by 4,330 kw. This turbine was built for these conditions but is now operating at lower pressure and temperature. The cost of this improvement would be $287,000. The cost of production of the additional capacity would be 3.09 mills per kwh. at 100% load factor or 3.80 mills per kwh. at 60% load factor.

To make available to the area south of Walsenburg the additional capacity of the Walsen Plant, a 44 kv. line should be constructed paralleling the present 22 kv. line from Walsenburg to Trinidad. Such a line would be 40 miles long, cost $86,000, and require 171,500 pounds of No. 1 copper.

-10-

A 5,000 KW. UNIT AT DAWSON

A unit having a dependable capacity of 5,000 kw. could be installed at Dawson at a cost of $492,000 for necessary boiler and generating equipment. Production costs for such a unit at this location would be approximately 2.75 mills per kwh. at 100% load factor, or 3.75 mills per kwh. at 60% load factor.

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A 1,000 KW. UNIT AT DURANGO

A new unit having a dependable capacity of 1,000 kw. could be installed at Durango at a cost for necessary boiler and generating equipment of $125,000. Production costs would be approximately 6.23 mills per kwh. at 100% load factor, or 8.34 mills per kwh. at 60% load factor.

SURVEY OF POTENTIAL INCREASE IN PRODUCTION OF STRATEGIC AND CRITICAL MINERALS IN THE STATES OF COLORADO AND WYOMING

and the

APPROXIMATE INCREASED ELECTRIC POWER REQUIREMENTS

June 1, 1942

GUSTAVUS SESSINGHAUS
Mining Engineer
Denver, Colorado

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June 1, 1942

GUSTAVUS SESSINGHAUS
Mining Engineer
Denver, Colorado

GUSTAVUS SESSINGHAUS
Mining Engineer
1520 Gaylord Street
Denver, Colorado

January 8, 1943

Hon. Clifford H. Stone,
Director Colorado Water Conservation Board,
Denver, Colorado.

Dear Sir:

I hand you herewith copy of my report entitled - "SURVEY OF POTENTIAL INCREASE IN PRODUCTION OF STRATEGIC AND CRITICAL MINERALS IN THE STATES OF WYOMING AND COLORADO, and the APPROXIMATE INCREASED ELECTRIC POWER REQUIREMENTS."

I desire to emphasize that the studies were made on the basis of war and emergency conditions. The production tonnages and power requirements are those that might rather readily materialize within a year or so. Consideration was not given to those conditions where extended programs of exploration and development would have to be carried out and elaborate plants erected to secure commercial products. The conclusions are as of June 1, 1942.

Respectfully,

Gustavus Sessinghaus

GS:CLS

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The purpose of the survey was to determine as closely as might be possible, the potential production of war minerals in Colorado and Wyoming. Consideration had to be given, in the larger aspect, to properties that are not operating. Producing properties that might be capable of increasing production were also considered. Certain criteria had to be kept in mind - but, by reason of war conditions, these criteria could not be followed inflexibly. Considerable judgment had to be exercised.

Today, the approach to the question of availability of ore bodies must be from the war standpoint, the objective being the production of ore within a reasonably short time, that is, within a period of one year. In the heavy snow country, any necessary installation of equipment must be completed before the permanent snow comes. Properties requiring long and extended programs of development were excluded.

The writer hereof, for more than thirty years, has been a consulting and operating mining engineer throughout the Rocky Mountain region. From study, inspection and operating experience, he is personally familiar with most of the mineralized areas and the production thereof in the two states covered by this survey. Definite inspections of properties were not made at this time. The most reliable and dependable information was sought. Official and authentic publications were consulted and official production records of areas and individual properties were studied. Probable periods of preparation to get into production were given consideration. His own knowledge and understanding of a number of the areas extends over a considerable period of years.

In the states under consideration, the investigations have been restricted to the main mineralized areas in which the manner of the ore occurrence and the habit of the ore bodies is pretty well understood. The main mining activities are contiguous to established communities and, in only a few more distant localities, is it necessary to provide housing for the men. Better roads for transportation have already been provided and, in most cases, the power lines are close at hand. In general, the content of the base metals in the ores is much higher than in the ores from which some of the large metal production is now being secured. The presence of precious metals, in most instances, assists in making the operations commercially feasible. Through consolidation and centralization, more efficient operations can result with a consequent reduction in the needed man power.

The metals to which special attention has been given are copper, lead, zinc, tungsten, molybdenum, manganese, chrome and iron, and also fluorspar. There are deposits carrying copper, lead and zinc in Colorado; tungsten and molybdenum in Colorado; iron in Wyoming; and fluorspar in Colorado. The fluorspar is essential in steel production but the tonnage is small and most of the deposits are now operating. There is also a chrome situation in Wyoming. There is some development of manganese ore at scattered points in Colorado but the tonnage would be small.

I desire to again emphasize that the survey covers potential increases in production.

I give, herewith, my analysis of the two states and comments that might lead to a better understanding of the situations prevailing. I will now take up the individual states and the different areas.

WYOMING

In bulletin 507 U.S.G.S., 1912, "The Mining Districts of the Western United States," Lindgren says:

> "The State of Wyoming contains few and scattered metal beering districts and its production is limited to a little gold and silver. Wide stretches of high plains or high plateaus underlain by horizontal Tertiary and Cretaceous sediments extend over the eastern and southwestern parts. The several uplifts of the Rocky Mountains traverse the State in a northwesterly direction and comprise a number of high ranges, usually exposing a large core of pre-Cambrian rocks surrounded by upturned Paleozoic and Mesozoic sediments. There is little or no evidence of the late Mesozoic intrusions promoting mineralization."

Actually, there has been comparatively little metal production in the State of Wyoming. There are a few scattered gold districts and, in certain parts, as, for instance, the Laramie Mountains, there are scattered lenses of low grade copper. In the years 1936 to 1940, inclusive, the total metal production has been less than $200,000, being

principally gold and silver. According to the Bureau of Mines yearbook for 1940, the total metal production of the state of Wyoming from 1867 to 1940, inclusive, has been $7,553,103, of which 75% was in copper, the balance in gold with only a little silver, only eight tons of lead and no zinc. The bulk of the copper was mined before 1924 in the Encampment district and the Hartville district. The latter district includes what is now the Sunrise iron mine of the Colorado Fuel and Iron Corporation. The Sunrise mine was opened first as a copper mine and then developed into the big iron mine. The figures given above do not include the production of iron.

The Sunrise iron property is a good grade of ore, principally hematite, and there are other deposits of iron ore known in Wyoming; these, however, have not been exploited and mined. The production of iron ore in Wyoming in 1940 was 831,314 long tons. This production represents a large increase over previous years. To increase production much further would require exploration and development of another deposit. This would take one and one-half to two years to get onto an economical basis of operation. There would have to be certainty of a market for the ore before there could be justification for such an undertaking.

There are also known, in southern Wyoming, large deposits of ilmenite or titaniferrous iron ore. At the present time, this titaniferrous iron ore does not appear to have much value. While both titanium and iron ore are of considerable value by themselves, the particular form in which the ore occurs seems to have resulted in metallurgical difficulties and, as a consequence, the property has not yet

been opened up. Work is now being done in an attempt to separate the titanium from the iron. There is a wide use for titanium as a paint pigment and, also, for use in an alloy.

It seems unlikely at this time that there will be increased demand for power in any substantial quantity at Sunrise.

Casper Mountain Chrome:

This property lies on Casper Mountain. There are several claims, held in part by location, and, in part, by lease on State land. The ore occurs in streaks or lenses, and the mineral particles are mostly small, being disseminated in the ore bodies. Concentration is necessary. There has been some stripping done and some pits sunk. There are numerous lenses, some of them parallel to each other but lying in an elongated zone. The U. S. Bureau of Mines has made an investigation of the property, having trenched, sampled and put down some diamond drill holes. The mineral is high iron, making a low grade concentrate. The Metals Reserve Company has contracted to purchase 100,000 tons of concentrate. Preparations for mining and milling are now being made to produce 500 tons daily of ore and about 100 tons of concentrates. The mill will be located near Casper. The different streaks or lenses vary in their mineral content.

Approximate power requirement 750 H. P.

At this writing, this would seem to cover the Wyoming situation within the purview of the survey.

COLORADO

In the annals of mining history in the Western United States, Colorado is an old state. Gold was discovered at Idaho Springs in 1859. Silver at Montezuma in 1864. The migrations of the prospectors and miners very rapidly took them to practically all parts of the mountains that seemed promising. Great excitement prevailed and many mining locations were made. The prospectors understood and recognized the high grade ores that occurred at the surface. The lode deposits at Leadville were discovered in 1877. Only Creede and Cripple Creek were discovered somewhat later (in 1891). The early mining was of ores that could stand high costs in mining, transportation and smelting.

The so-called refractory ores were passed by, or were rich enough in precious metals, so that they could stand the higher smelting charges that had to be imposed. The refractory character was usually due to the zinc in the ore. Zinc as a metal has properties quite different from copper or lead and cannot be recovered with these metals, whether they are smelted together or smelted separately.

In the ordinary smelting processes, gold and silver are collected by the lead or copper, and then recovered from the lead or copper in the refining operation. When there is an appreciable amount of zinc in the charge, special treatment must be given to the furnace. Some of the zinc will burn off and go out the top of the furnace - the balance must be got rid of in the slag. There are usually somewhat greater losses of precious metal when there is an appreciable amount of zinc in the slag. So, from every standpoint, it is undesirable to have

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zinc present in an ore that is going to a lead or copper furnace. The problem then has been to keep to a minimum the zinc in the ore. This had to be done by careful hand sorting or by milling. But, not until the flotation process was developed and gotten under good control, could the zinc be satisfactorily separated and sent to a zinc smelter where the zinc could be saved.

By the older milling methods, the losses in precious metals and lead and copper were heavier. So, in many places, mining had to cease as it was no longer profitable. This, too, was before the period of electric power, better roads and truck transportation. Until recent years, there has been a lack of milling facilities for complex ores which would permit a small operator to have his ore milled on a toll basis. And, for several years in the 1930's, the price of zinc was so low that it would hardly pay to load a 50% zinc concentrate for shipment to a zinc smelter.

BOULDER COUNTY: - Tungsten.

The main tungsten area in Boulder County lies in the western part of the county. It is about ten miles long and Nederland is the central point. There are some small outlying areas over the line in the north end of Gilpin County. Most of the work that is being done now is in old properties or on veins that have heretofore been known. Numerous veins, mostly narrow, carry ferberite, the iron tungstate. Numerous properties are now in production, mostly small. Some high grade ore can be hand sorted but most of it must be milled. Some explorations by diamond drilling are being made by the U. S. Government. Not much

tungsten is known outside of the recognized tungsten area. New exploration would involve a re-opening of old mines, together with drifting and sinking. It might also be sinking from the surface where the ground had not been previously opened up. In general, there is only a little water to pump. The deepest shaft is 800 feet, but most of the work is shallower. Most of the work is done by lessees. There are custom mills which will mill the ore on a toll basis and, also, mills which will purchase the ore outright on analysis at a price per unit that varies according to the grade but makes allowance for the milling cost, metallurgical loss and marketing costs. There is now ample milling capacity and one new mill is being built of 50 tons daily capacity which is expected to make improved recovery on the "horn" ores, in which the mineral is very finely divided and the horn very hard.

The present price of $24.00 per unit for 60% ore or concentrates is low for war conditions. It would seem that some additional exploration at present prices would be justified and certainly a substantial advance in price should attract a good many prospectors and miners. The production in terms of tonnage is small but increase of about 150 tons per day would seem to be justified.

Approximate power requirement 150 H. P.

CLEAR CREEK COUNTY:

Since the advance in price of gold and the stabilization of silver, there has been considerable activity in mining. Numerous small mills have been built, principally in the Idaho Springs section, and these mills are doing custom milling. As the price of zinc had been very

low for several years, the mills did not make provision for differential separations. Only a bulk concentrate was made and the zinc was lost. With the higher value prevailing for zinc, some of the mills will be obliged to put in additional equipment to save the zinc. Certain of the mills running on ores too low in zinc to justify saving it will continue as they are. It seems inevitable that larger mills will be built, making better zinc recovery and operating more efficiently.

Idaho Springs.

There are now numerous operations in the vicinity of Idaho Springs; mostly, however, primarily for precious metal. There are a number of veins of the galena-sphalerite type that should now be mined. I think about 450 tons per day could be produced.

Approximate power requirement 900 H. P.

Georgetown and Silver Plume.

There is a rather extensive belt, highly mineralized, extending along Clear Creek from Georgetown through Silver Plume and beyond for a few miles. Many of the veins have been mined in the past, having been valuable principally for the silver but carrying considerable lead and, in places, zinc. The country is rather rugged and the canyons are rather deeply cut so that, to a large degree, the properties could be mined through tunnels or adits. The richer values in silver were closer to the surface but most of the veins carried lead and sufficient zinc so that a careful sorting for the elimination of the zinc was necessary. A number of shafts have been sunk below the main tunnel levels and, so

far as is recalled, none of the ore shoots have been bottomed so that the depth to which lead and zinc might be found has not yet been determined. There are many veins in this general locality and there have been many miles of underground workings. Much zinc bearing ore was left in the mines. Part of the work would be done above the tunnel levels but most of the work would appear to be necessary below the tunnel levels. All these properties are quite close to a main paved highway.

While reference has been made to mines which have been already extensively worked, there are also veins and groups of veins which are still largely virgin in that very little work has been done upon them. Additional milling facilities will be required.

I believe 650 tons daily of lead zinc ore can be expected.

Approximate power requirement 1,300 H. P.

Urad.

A molybdenum mine several miles west of Empire. This property will reopen soon with output of 300 tons daily. Milling will be required.

Approximate power requirement 500 H. P.

GILPIN COUNTY:

Central City.

There is a central area in which copper prevails as the base metal, in addition to the precious metal; and a northern and western in which lead and zinc prevail. There are numerous properties which have been mined in the past and which could be reopened. I would expect

that 250 tons of lead, zinc ore and 200 tons of copper ore could be produced daily.

Approximate power requirement 1,125 H. P.

SUMMIT COUNTY:

Montezuma.

The mining area contiguous to the town of Montezuma has numerous veins and properties that have been opened in the past. Some of these properties were operated in a rather substantial way and made some nice profits; others, again, were small and did not produce much. In general, though, the veins run small. The base metal seems to be concentrated in narrow seams or veins instead of being disseminated through the gangue material. In some of the veins a barite gangue was encountered which gave considerable trouble in the milling of the ore. There were also some manganese minerals which caused some trouble in the older methods. Present day metallurgy, however, has overcome most of the difficulties that have prevailed in the past.

I would expect that the territory could increase 250 tons per day of lead zinc ore.

Approximate power requirement 550 H. P.

Ten Mile.

Embracing Frisco, Kokomo and Robinson, along Ten Mile Creek. This section has had heavy production in the past, but has been down for many years. The ores were heavy sulphides of lead, zinc and iron, with precious metal value. Some work is now being done. There are veins

and replacements in the sediments. The Wilfley property is now getting ready for a mill.

Based on my information, I would expect the area to produce 500 tons per day of lead zinc ore.

Approximate power requirement 1,000 H. P.

Breckenridge.

In Professional Paper 176, U.S.G.S. 1934, "Geology and Ore Deposits of the Breckenridge District," on page 59, T. S. Lovering says:

> "Only a small part of the Breckenridge District has been studied by the writer. Most of the known ore has been exhausted in this special area, but the relation of ore to structure seems established, and there are some places where the writer believes that more work should be done."
>
> * * * * * * * * * *
>
> "In conclusion, the amount of known ore left in the special area is a very small part of that originally present, and the discovery of additional ore will probably depend on the correct interpretation of the structural geology. Geophysical work in areas that are structurally favorable for occurrence of ore, supplemented by core drilling, will probably be the most economical method for ore hunting in most places, although the western continuation of the Wellington main vein can probably be cheaply

"prospected by means of test pits."

I think the tonnage, lead zinc ore, can be increased about 100 tons daily.

Approximate power requirement 250 H. P.

PARK COUNTY:

Alma.

There are some old properties, easily accessible, that could be put into production rather quickly. Milling facilities involved have to be provided. The ore would be pretty good grade. There is zinc, lead, and some copper. I would say 200 tons daily of new ore could be produced.

Approximate power requirements 450 H. P.

EAGLE COUNTY:

Red Cliff.

On the Western side of the main Continental Divide, thirty miles west of Leadville, is the New Jersey Zinc Company's property. This large property, with millions of tons of zinc ore in reserve, is now milling 600 tons in an underground mill. Will increase output by building another mill of 600 tons capacity.

Approximate power requirement 1,000 H. P.

LAKE COUNTY:

Leadville.

Leadvill has been one of the outstanding mining camps of the world and its production has been exceeded by very few. Very early in

the history of the camp, studies of the ore occurrence were made by Mr. S. F. Emmons, supported by a staff of capable assistants. The work of Emmons was outstanding and his ideas and conclusions contributed heavily to the intelligent exploration and development of the mining properties in Leadville.

The ores of Leadville were of great variety, some of them highly complex. In addition to the precious metals, there were large bodies of oxides and sulphides of lead, zinc and iron. There was copper in subordinate amounts. The bodies of ferruginous manganese ore were large.

The mines were operated through shafts and the ground was very wet. All the mines had to do considerable pumping. After some years of mining, the Yak Tunnel was driven into Breece Hill, draining that part of the camp but the portal of the Yak Tunnel lies slightly above the collar of the Penrose shaft in the Downtown area so practically all of the main camp of Leadville is now under water. Exploration and development through the Yak Tunnel has been going on for several years and mining operations have already been resumed but a further extension of mining in the Leadville section involves the unwatering of large areas. There are several so-called basins, separated from each other by faults that are tight so that individual areas can be unwatered without the necessity of unwatering the other areas but there is some overflow from one basin into another.

In the broader aspect, the contemplation of further production in the Leadville area involves unwatering of the individual basins

or all of them. A tunnel has been spoken of but that would require about eighteen months time to reach the Penrose shaft and then another eight months to drive from the Penrose to the Greenback shafts and another eight months to drive from the Greenback to the Cord Winze. The alternative would be to pump through the shafts and, based on past experience, in all probability at least eighteen months would be required to drain the ground - several more months to catch up the old workings and rehabilitate the mines but, with all this done, there is no assurance that a large, steady production of war minerals could be secured.

When the last work was suspended in the Downtown area and, also, on Carbonate Hill, there were no known ore reserves of importance left behind. There is some territory on the West slope of Carbonate Hill and there are, also, some areas on Friar Hill and in Big Evans that are either known to have some ore or are essentially virgin so that there is good probability of disclosing some ore by sufficient exploration work; however, it is evident that a large time factor must intervene before any substantial increased production could be expected and, even then, there is no certainty that the expense of unwatering would be returned. Some methods of exploration might be worked out so that the presence of substantial ore bodies in the virgin territory might be established before unwatering were undertaken.

I realize very fully that the view that I express here is not a very popular one but it is based on personal knowledge of conditions in the Downtown area and information with respect to other areas, given to me by men whose judgment I highly regard. I have been speaking with gold, silver, lead and zinc, principally in mind. There are, on the

contrary, recognized reserves of ferruginous manganese ore, many of which are definitely known as to their position and approximate grade. Estimates have been made and a figure pretty generally accepted that there are two million tons of oxidized ferruginous manganese ore that could be mined. It is estimated that there are also two million tons of manganosiderite which is the original carbonate form from which the oxidized ores are derived through alteration. The use of the manganosiderites, however, would present a new problem to fit them for use in the steel industry. The ferruginous manganese ores are low grade, averaging perhaps around 22% manganese and, in ordinary times, having a very low money value. The mining of these ores of themselves would not justify any expense for unwatering under anything except extreme war and emergency conditions.

During the last war, when the district was unwatered, some selective mining was done and smaller quantities of the higher grades of ferruginous manganese ore were mined for shipment to furnaces that were mixing the ore with high grades that were low in iron. Under the stress of conditions then prevailing, the steel plants were getting along with lower grades of ferro manganese - namely 72% manganese instead of 78% to 82%.

A great deal of work has been done on the Leadville ferruginous manganese ores by the Bureau of Mines and private investigators but, thus far, no method has been found for beneficiating the ore and eliminating a considerable part of the iron. The iron and manganese are combined chemically and only expensive chemical methods would seem to apply and

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present conditions of war emergency do not justify the expense and time necessary in unwatering the areas to make the ores available and to put in the necessary chemical plants to secure products suitable for manufacture of ferro manganese.

Today, the only plant that could use the Leadville ore is that of the Colorado Fuel and Iron Corporation. They could use some of the ore for making a small addition of manganese to their pig iron. But they object to the ore on account of a little zinc that is in it which, they believe, injures the linings of their furnaces. They can usually secure elsewhere what manganese they need in their blast furnaces and take from Leadville only intermittently. Their requirement can be met from ore bodies above the water level that are readily accessible. This amount would be about 25 tons per day.

In addition, perhaps, some 300 tons daily of lead zinc ores could be secured without much expense for unwatering, making 325 tons daily of new production.

Approximate power requirement 700 H. P.

CHAFFEE COUNTY:

Salida - fluorspar.

Along the Arkansas River, a few miles north of Salida, there has been some mining and production of fluorspar. One small mill is now in operation; further development is going on and it would seem likely that, with additional development, a production of perhaps 150 tons of milling grade ore could be secured for which milling facilities would have to be provided. Some shipping grade ore could be produced by hand

sorting and some acid grade could be produced by milling.

Approximate power requirement 300 H. P.

SAGUACHE COUNTY:

Bonanza.

The principal properties that had been operating in the past have had substantial precious metal value, principally silver. The lead content exceeded the copper content. At the present time, the Cocomongo is standing idle. There is a complete surface plant on the property, including a mill of about 75 tons daily capacity.

On the Rawley ground, there is a second vein, known as the Dr. Clark Vein, which was cut by the drainage tunnel. On account of the low precious metal content, this vein has not been extensively explored. However, it does carry lead and zinc, perhaps to the amount of 20% or better, combined. A limited amount of this ore was mined some years ago. However, it seems likely that further exploration on the vein would permit mining, say 100 to 150 tons a day. The ground above the tunnel is badly faulted and, so far as is known, the Dr. Clark Vein does not outcrop. The ore can be shipped crude if it has about 30% combined lead and zinc content. It would be more profitable, however, to separate the zinc and lead, shipping the different products to their respective smelters. Ore which would not stand shipment, as is, for use in the manufacture of pigments, could be beneficiated and separate lead and zinc products made.

The main Rawley Mine is drained by the tunnel. It has been in the hands of lesse s and is probably in such condition now that further

production might not be expected.

Further developments on the Dr. Clark Vein below the tunnel level would require some pumping but the inflow would not be very great.

Production of the camp could probably be brought up to 200 tons daily, of lead zinc.

Approximate power requirement 400 H. P.

Manganese.

The Pershing manganese mine lies about four miles from Bonanza and about twelve miles from Villa Grove, the railroad town. This property has been known for a long time and has been operated intermittently. The ore, as mined, runs only a little over 30% and is of low value. It cannot be used straight for the manufacture of ferromanganese. The ore was an original carbonate associated with quartz in a regular vein form. Close to the surface, the manganese carbonate has been oxidized and, apparently, most of the oxidized ore has been removed. However, the government is diamond drilling to determine the extension of the ore along the strike of the vein and, also, at depth. Should the exploratory work disclose a substantial ore body, a flotation mill would have to be installed to separate the manganese from the quartz and the manganese concentrate then calcined and nodulized. The capital expenditure for such a plant is very heavy and, to justify such an expenditure, would require a very large tonnage of ore definitely proven.

GUNNISON COUNTY:

White Pine.

There could probably be a production of 150 tons per day of

lead zinc ore from two or three different properties.

Approximate power requirement 300 H. P.

HINSDALE COUNTY:

Hinsdale County lies over the range just east of San Juan County. There is not now public utility service in the mining area. There is a small hydro plant at Capitol City, about eight miles from Lake City, up Henson Creek. The transmission lines have been carried several miles further up Henson Creek. The Ute-Ulay has water power for its own need, although seasonal. There is a 50 ton mill with Diesel. A five mile power line would have to be built from Animas Forks to Lake Fork. From there, it would be twenty miles to Lake City.

I do not believe that, under the circumstances, the construction of transmission lines would be justified. As the properties are scattered, they could probable be better served by Diesels. Then, too, there is a transportation problem, as Lake City is about forty-five miles from the railroad at Iola, and the mines would be still further away.

Lake Fork.

Immediately over Cinnamon Pass, east of Animas Forks, in San Juan County. Several properties operated and shipped years ago. Transportation costs were too heavy on crude ore. Copper base, some lead and zinc. Practically a virgin area with considerable development already done. Should produce quickly 300 tons daily.

Lake City.

Production could probably be increased 250 tons daily of lead

zinc ore from several properties.

SAN JUAN COUNTY:

Silverton.

There are several properties in the vicinity of Silverton which should be in production. There are some properties in which some development had been done, others again which had been mining years ago but are now about down. The Pride of the West had a fire at the mine that burnt down the mine buildings. They are rebuilding and, also, increasing the capacity of the mill. The Highland Mary has been down for the winter but will resume shortly.

The development of the Silver Lakes group at Silverton has been in progress for three or four years. This development is through a cross cut from the Mayflower tunnel which cut the veins a considerable distance below the old workings. This should add 250 or 300 tons to the daily output of the camp.

The Old Hundred has ore reserves well opened up and ready to go except for making necessary repairs. A new tram rope is needed. There is a 100 ton flotation mill inside a very large building. Capacity could be readily increased.

The Lackawanna has a new 75 ton mill that has not operated.

There are also a number of mill buildings that would be serviceable.

There could be new production around Silverton of at least 650 tons per day of lead zinc ore.

Approximate power requirement 1,300 H. P.

Eureka.

The Sunnyside property has been down for several years. The 1000 ton mill at Eureka was completely overhauled three or four years ago and could start up very quickly. A lower tunnel was started to cut the ore at greater depth. This work has not progressed very far. But there is a shaft down 800 feet below the present tunnel level. This could be unwatered rather quickly and ore secured to help keep the mill operating while the tunnel was being driven. Outside ore could be secured from other properties in the vicinity to help keep up the tonnage. This is lead zinc ore.

Approximate power requirement 1,500 H. P.

Animas Forks.

There are several properties near Animas Forks that are in ore that had considerable zinc. There is also lead. Some of these need some further development. They have been down for years. They should be able to produce 300 tons daily.

Approximate power requirement 750 H. P.

OURAY COUNTY:

Red Mountain.

The Treasury Tunnel has a 300 ton mill, new. They have done additional development and put property in good condition. Other smaller properties could get into production. I would consider 500 tons daily production feasible - mostly lead and zinc but some copper.

Approximate power requirement 1,100 H. P.

Ouray.

There is some lead zinc in the Camp Bird, at Sneffels, and lead in different places, closer to town. The production could be increased 200 tons daily.

Approximate power requirement 500 H. P.

SAN MIGUEL COUNTY;

Telluride.

Telluride is now milling over 400 tons per day. Could increase 200 tons per day of lead zinc ore from present operations and new work.

Approximate power requirement 400 H. P.

Ophir.

Present operations can increase; the Butterfly, shut down by fire, can rebuild and some new production secured. At the Alta, plenty of ground opened up. Needs larger mill.

Total increase should be 300 tons per day of lead zinc ore.

Approximate power requirement 600 H. P.

DOLORES COUNTY:

Rico.

Rico has plenty of ore, known or developed. Should be able to increase 250 tons per day of lead zinc ore.

Approximate power requirement 500 H. P.

CONCLUSION

The approximate additional electric power requirements stated in terms of kilowatts represent the power required to mine the ore, put it on the surface, and mill or otherwise prepare it for shipment to the smelter. Where there are already milling facilities available, no additional power will be required for milling. No additional power was figured separately for the smelter at Leadville in Colorado as the smelting operations can be substantially increased without making additional power demand. In general, the smelters do not use much power. The Leadville smelter will only take lead and lead-copper-iron concentrates; the zinc concentrates, which will represent the larger tonnage, will be shipped outside of the territory involved.

In determining the horse power requirement for the respective districts, the nature of the operations had to be given full consideration. Some of the factors that control the power requirement are daily tonnage, size and hardness of ore body, depth of workings, amount of water to pump and so forth. In the mill, the hardness and structure of the ore, and kind of treatment that must be given determine the power required. In general, the small mines and mills take more power per ton of ore produced than the larger ones.

The coincidental demand, as shown, is the total of the individual demands reduced by a certain factor that applies to the particular type of operations prevailing in a district. It arises out of the fact that at no time are all the installations running at full load. Only where there is a single installation, is the coincidental

demand equal to the individual demand. The coincidental demand becomes smaller in percentage as the number of small operations increases. Thus, in the conversion of total individual demand into coincidental demand, the factor was unity for a single large operation and dropping to 55% where there were several small operations.

In reviewing the statements made hereinbefore, with respect to vital natural materials necessary to the war effort and occurring in the states of Wyoming and Colorado, it appears that important production can be secured rather quickly. No attempt has been made to point out where the larger reserves might be or to evaluate them. To open a new property, prepare it for regular production on a substantial basis, work out the proper metallurgy and erect the mill, takes considerable time, ordinarily one and one half to two years. While I have not discussed those situations where the preparation for production would take a considerable period of time, I do want to emphasize that there are such places where production can be secured when the need arises.

In looking over the essential natural war materials available in the two states, we find that the new production will embrace chrome, fluorspar, tungsten, molybdenum, ferruginous iron, copper, and lead zinc, as ores or concentrates.

Wyoming

The chrome production on Casper Mountain in Wyoming will be essentially new production for the state, although, during the last war, a small tonnage was mined from a property on Deer Creek, about

thirty miles east of Casper. This small deposit is believed exhausted. The Casper Mountain deposit has been discovered since then. A production of 500 tons daily of crude ore seems assured with a coincidental demand of 560 kilowatts. A simple crushing and tabling will do the necessary concentration. This area is served by Mountain States Power Company.

Colorado

Lead and zinc have been grouped together. In most instances the lead and zinc are associated together in the ores. In general, the zinc will predominate and, in quantity, may be double the lead. In Eagle County, the ratio of zinc to lead will be higher. In the counties lying to the northwest and west of Denver, the estimate of potential daily increased tonnage of lead zinc ore is 3,300 tons.

The copper area of Gilpin County can produce new daily tonnage of 200 tons. Boulder County can increase 150 tons of tungsten ore; Lake County can produce 25 tons of ferruginous manganese ore and Clear Creek County 300 tons of molybdenum ore.

Thus, there can be a total daily production of 3,975 tons with a coincidental demand of 3,930 kilowatts for the counties of Boulder, Clear Creek, Gilpin, Summit, Park, Eagle and Lake. The Counties are served by Public Service Company of Colorado.

Chaffee County can produce 150 tons of fluorspar, Saguache County 200 tons lead zinc ore, Gunnison County 150 tons lead zinc ore, making a total tonnage of 500, with a coincidental demand of 590 kilowatts. These counties are served by Public Service Company of

Colorado.

Hinsdale County can produce 300 tons copper base and 250 tons lead zinc ore but can probably be better served by Diesel Power and some small water powers. Hinsdale County, is therefore, not considered as requiring additional utility power.

The Southwest part of the state, usually referred to as the San Juan section, can produce 3,400 tons daily, of lead zinc ore, total coincidental demand 3,447 kilowatts. The counties included are San Juan, Ouray, San Miguel and Dolores, and are served by Western Colorado Power Company.

The above tonnage aggregate 8,425 tons for the State of Colorado with total aggregate coincidental demand of 7,967 kilowatts.

There may be some isolated, detached and scattered small mining operations producing lead, zinc, copper, manganese, fluorspar, mica and vanadium but these will make no demand for electric service.

From the above, it appears that the grand total of potential increased production of strategic and critical minerals in the states of Colorado and Wyoming is 8,925 tons, with a coincidental demand of 8,527 kilowatts.

Attached hereto are tabulated summaries of "Potential Increase in Daily Tonnage Production" and the "Approximate Power Requirements."

(Signed) Gustavus Sessinghaus
Mining Engineer

Denver, Colorado
June 1, 1942.

SUMMARY OF POTENTIAL INCREASE IN DAILY TONNAGE PRODUCTION

COLORADO:	Lead & Zinc Bearing Ores	Copper Bearing Ores	Tungsten and Other Ores
BOULDER CO.			150 Tungsten
CLEAR CREEK CO.			
Idaho Springs	450		
Georgetown and Silver Plume	650		300 Molybdenum
Urad			
GILPIN CO.			
Central City	250	200	
SUMMIT CO.			
Montezuma	250		
Ten Mile	500		
Breckenridge	100		
PARK CO.			
Alma	200		
EAGLE CO.			
Red Cliff	600		
LAKE CO.			
Leadville	300		25 Ferruginous Manganese
CHAFFEE CO.			
Salida			150 Fluorspar
SAGUACHE CO.			
Bonanza	200		
GUNNISON CO.			
White Pine	150		
HINSDALE CO.			
Lake Fork		300	
Lake City	250		
SAN JUAN CO.			
Silverton	650		
Eureka	1000		
Animas Forks	300		
OURAY CO.			
Red Mountain	500		
Ouray	200		
SAN MIGUEL CO.			
Telluride	200		
Ophir	300		
DOLORES CO.			
Rico	250		
WYOMING:			
NATRONA CO.			
Casper Mountain			500 Chrome Iron
	7,300	500	1,125

Total Tonnage . . . 8,925

SUMMARY OF APPROXIMATE POWER REQUIREMENTS

	Increase in Potential Daily Tonnage		Total Daily Individual Demand		Coincidental Daily Demand in K. W. on Utility Systems	
	Tons		H.P.	K.W.		
COLORADO:						
BOULDER CO.	150		150	112	80	
CLEAR CREEK CO.						
Idaho Springs	450		900	672	400	
Georgetown and Silver Plume	650		1300	970	533	
Urad	300		500	374	374	
GILPIN CO.						
Central City	450		1125	840	462	
SUMMIT CO.						
Montezuma	250		550	410	226	
Ten Mile	500		1000	746	485	
Breckenridge	100		250	187	112	
PARK CO.						
Alma	200		450	336	200	
EAGLE CO.						
Red Cliff	600		1000	746	746	
LAKE CO.						
Leadville	325	3,975	700	522	312	3,930
CHAFFEE CO.						
Salida	150		300	223	157	
SAGUACHE CO.						
Bonanza	200		400	294	209	
GUNNISON CO.						
White Pine	150	500	300	224	224	590
HINSDALE CO.						
Lake Fork	300					
Lake City	250	550				
SAN JUAN CO.						
Silverton	650		1300	970	533	
Eureka	1000		1500	1120	1120	
Animas Forks	300		750	560	307	
OURAY CO.						
Red Mountain	500		1100	820	492	
Ouray	200		500	372	224	
SAN MIGUEL CO.						
Telluride	200		400	294	209	
Ophir	300		600	448	300	
DOLORES CO.						
Rico	250	3,400	500	374	262	3,447
WYOMING:						
NATRONA CO.						
Casper Mountain	500	500	750	560	560	560
		8,925 Tons				8,527 Kilowatts

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